USER MANUAL

VePAL MX100e+/MX120e+

Metro Ethernet Analyzers

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1.0 About This User Manual

Every effort was made to ensure that the information contained in this user manual is accurate. Information is subject to change without notice and we accept no responsibility for any errors or omissions. In case of discrepancy, the web version takes precedence over any printed literature.

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This user manual is suitable for novice, intermediate, and experienced users and is intended to help you successfully use the features and capabilities of the VePAL MX100e+/MX120e+ test set. It is assumed that you have basic computer experience and skills, and are familiar with IP and telecommunication concepts, terminology, and safety.

For more technical resources, visit VeEX Inc web site at www.veexinc.com.

If you need assistance or have questions related to the use of this product, call or e-mail our customer care department for customer support. Before contacting our customer care department, you must have your product serial number and software version ready. Please go to the Basic Operations section for details on locating your unit serial number in the menus or locate the serial number on the back of the chassis. Please provide this number when contacting VeEX customer service.

Customer Care:

Phone: + 1 510 651 0500
E-mail: customercare@veexinc.com
Website: www.veexinc.com

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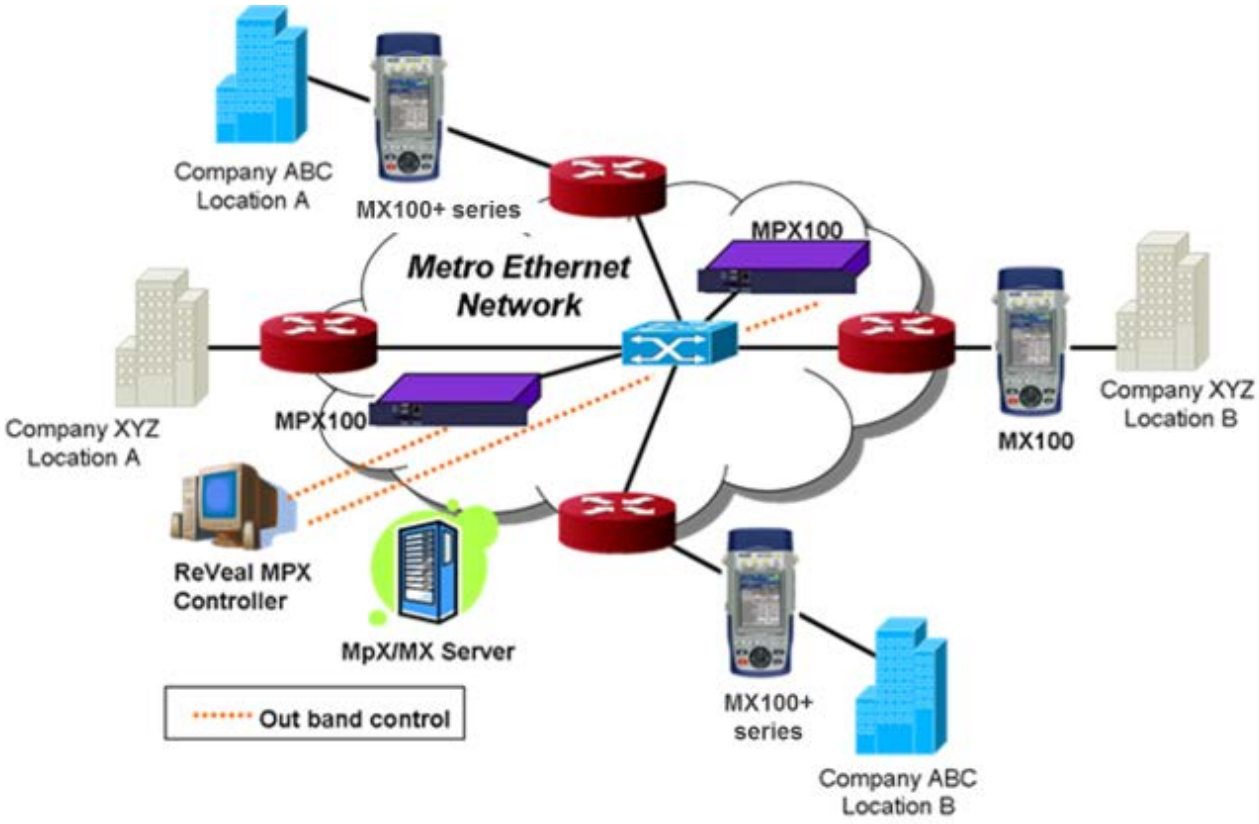
2.0 Introduction to MX100e+ and MX120e+

VeEX™ MX100e+ and MX120e+ Metro Expert test sets are the next generation of Metro and Carrier Ethernet field test equipment for Ethernet Networks. The units are lightweight, rugged and weather resistant, and feature Gigabit Ethernet and Fast Ethernet test ports complete with advanced Triple Play verification capabilities. The test sets can be used in conjunction with the MPX100

loopback device offering simplified network testing and monitoring. The MX100e+ shares all the same features as the MX100+ unit, with the additional support of 100Mbps optical on SFP. Note that any reference in this manual to MX100e+ applies to the MX100+ product and any reference to MX120e+ applies to MX120+ product, respectively.



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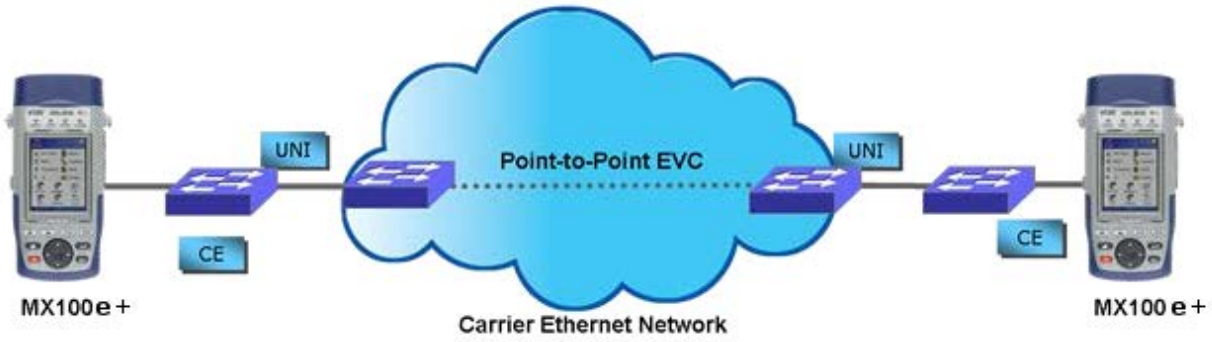
2.1 MX100e+ Introduction

The MX100e+ is part of the MX product family and is configured for:

- **Single Port Operation**
  - Single Copper port 10/100/1000Base-T
  - Single Fiber port 100FX/1000Base-X

- **Test Applications** (when the unit is operating in any of the physical ports above)
  - **BERT:** Unframed / Framed Layer 1, and Framed Layer 2/3 Ethernet traffic generation with user selectable test pattern for Bit Error Rate analysis.
  - **RFC 2544:** Throughput, Back-to-Back, Frame Loss and Latency conformance tests in accordance with RFC 2544 specifications.
  - **Throughput:** Ethernet traffic generation and analysis with multiple streams to verify network throughput and jitter.
  - **Loopback:** Loop back the transmitted data while swapping the source and destination addresses of the MAC, IP and UDP layers.
  - **V-SAM** test suite in conformance to ITU-T Y.1564 standard.

MX100e+ - End-to-End Performance Test Application



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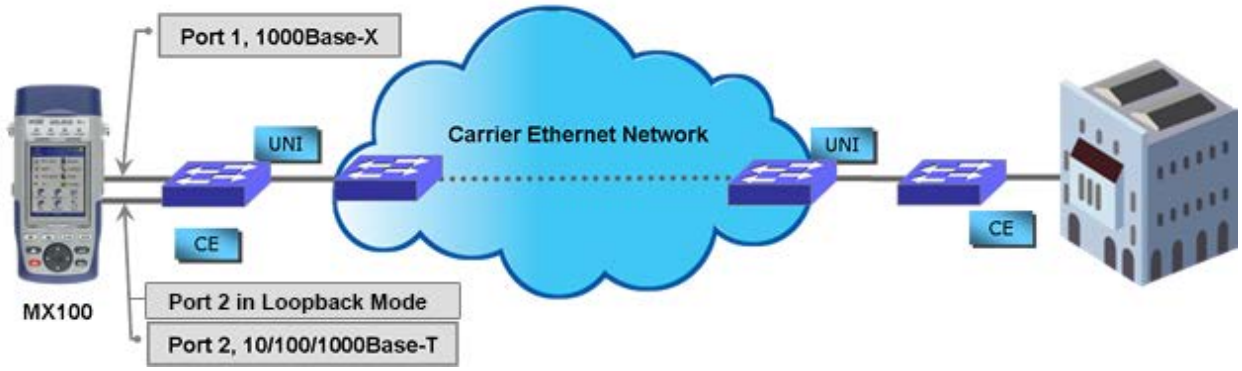
2.2 MX120e+ Introduction

The MX120e+ is part of the MX product family - in essence the MX120e+ is similar to having two MX100e+ units in one chassis. The default configuration of the MX120e+ allows for single port operation (same as the MX100e+), dual port operation, and pass through monitor mode. Pass through monitor mode enables bidirectional monitoring between the two 100Base-FX/1000Base-X ports or the two 10/100/1000Base-T ports.

- **Dual Port Operation**
  When the dual port interfaces and software options are enabled, the test set can operate a combination of two ports at the same time with the following physical port operation combinations:
  - Port 1 10/100/1000Base-T and Port 2 10/100/1000Base-T (copper ports only)
  - Port 1 100Base-FX/1000Base-X and Port 2 100BaseFX/1000Base-X (fiber ports only)
  - Port 1 10/100/1000Base-T and Port 1 1000Base-X (copper and fiber port combination)
  - Port 1 and Port 2
  - Port 1 (any application) and Port 2 (Loopback)
  - Port 1 (Loopback) and Port 2 (Loopback)
- **Test Applications**
  When operating in single port operation, any of the following test applications are available. When operating in dual port operation, one port can run any of these test applications while the other port provides loopback.
  - **BERT:** Unframed / Framed Layer 1, and Framed Layer 2/3 Ethernet traffic generation with user selectable test pattern for Bit Error Rate analysis.
  - **RFC 2544:** Throughput, Back-to-Back, Frame Loss and Latency conformance tests in accordance with RFC 2544 specifications.
  - **Throughput:** Ethernet traffic generation and analysis with multiple-streams to verify network throughput and jitter.
  - **Loopback:** Loop back the transmitted data while swapping the source and destination addresses of the MAC, IP and UDP layers.
  - **V-SAM** test suite in conformance to ITU-T Y.1564 standard.
  - Pass through monitor between two 10/100/1000Base-T copper ports or two 100Base-FX/1000Base-X fiber ports.

MX series - Dual Port Test Application



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3.0 Safety Information

Safety precautions should be observed during all phases of operation of this instrument. The instrument has been designed to ensure safe operation however please observe all safety markings and instructions. Do not operate the instrument in the presence of flammable gases or fumes or any other combustible environment. VeEX Inc. assumes no liability for the customer's failure to comply with safety precautions and requirements.

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4.0 Basic Operations

- **Keypad**
- **Touch Screen Display**
- **Battery**
- **Connectors and Panels**
- **LEDs**
- **Software Upgrade**

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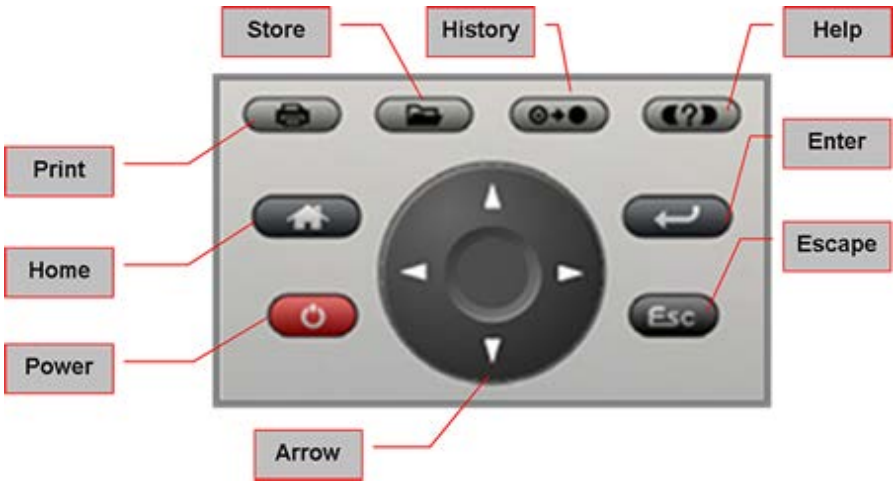
4.1 Keypad

The keypad comprises the following keys:



- **Power** key: The unit is powered on and off from the red key on the keypad. The button is recessed to prevent accidental power on. Press the key for 3-5 seconds to turn the unit on. To turn off the unit, press the Power key for at least 2 seconds. If the unit does not respond, holding the Power key down by more than 10 seconds will force the unit to switch off.
- **Save/Store** key: Saves test results in the unit's memory. If the measurement is still running, it will provide a snapshot the moment the key is pressed. The Save function provides automatic storage with automatic naming and time stamping function. To process a stored file, please go to Files.
- **Print** key: For future use.
- **History** key: The History key resets any blinking LED due to a history condition. For more details on the LED, please go to LEDs.
- **Help** key: The Help key brings the user to the online help, regardless of the current user interface location of the unit.
- **Home** key: Brings the unit to its home menu regardless of its location on the user interface.
- **Arrow** key: The Arrow key moves the cursor in any of the four supported directions (left, right, up, down). The Arrow key works in conjunction with the Enter and Escape keys.
- **Enter** key: The Enter key provides an enter sequence to the user interface. It is used in non touch screen operation mode to enter menus and functions.
- **Escape** key: The Escape key provides an escape sequence to the user interface. It is used in non touch screen operation mode to escape menus and functions.

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4.2 Touch Screen Display

The LCD supports touch-screen operation. To operate the touch-screen, use the stylus located in the top cover to navigate the menus and tabs. The unit can also be used in a non touch-screen mode (i.e., use the arrow, enter, and escape keys to navigate).

The location of the cursor on the screen is indicated by a focus state. The focus state varies depending on the function or section of the test set. Please observe the following precautions:

- Never use excessive pressure on the touch-screen as this may damage its functionality.
- Never use sharp objects such as a pen, screwdriver, etc., as this may damage the surface.
- Clean the surface of the touch screen using a soft cloth and mild detergent only. Do not use alcohol.

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4.3 Battery

The VePAL100+ chassis is equipped with an intelligent Li-ion rechargeable battery pack which is located in the rear of the unit. The battery will be partially charged upon delivery, so it is recommended to charge the battery fully before use. Please charge the battery at room temperature to preserve its life and to obtain maximum charge. The battery is charged during operation provided the unit is connected to the AC Mains using the supplied AC adaptor. Removing the battery while the unit is powered on is not recommended - this may result in damage. Remove the rubber cover on the left side to connect the AC Main adaptor to the unit.

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4.4 Connectors and Panels

The connector panels are located at the top and the side of the unit.

4.4.1 Test Ports

MX100e+ Test Interfaces

The MX100e+ is equipped with the following interfaces:

- **Electrical Ethernet Interface**
  - **Single 10/100/1000Base-T Port, RJ45 connector, IEEE 802.3 compliant**
    - A green LED on the RJ45 connector flashes when there is activity on the network
    - The green LED is On when there is a valid Ethernet link with the network and off when there is no link
- **Optical Ethernet Interface**
  - **Single 1000Base-X SFP Port, LC connector**
    - 1000Base-SX (850nm)
    - 1000Base-LX (1300nm)
    - 1000Base-ZX (1550nm)
    - 100FX (MX100e+)

MX100e+ Connector Panel

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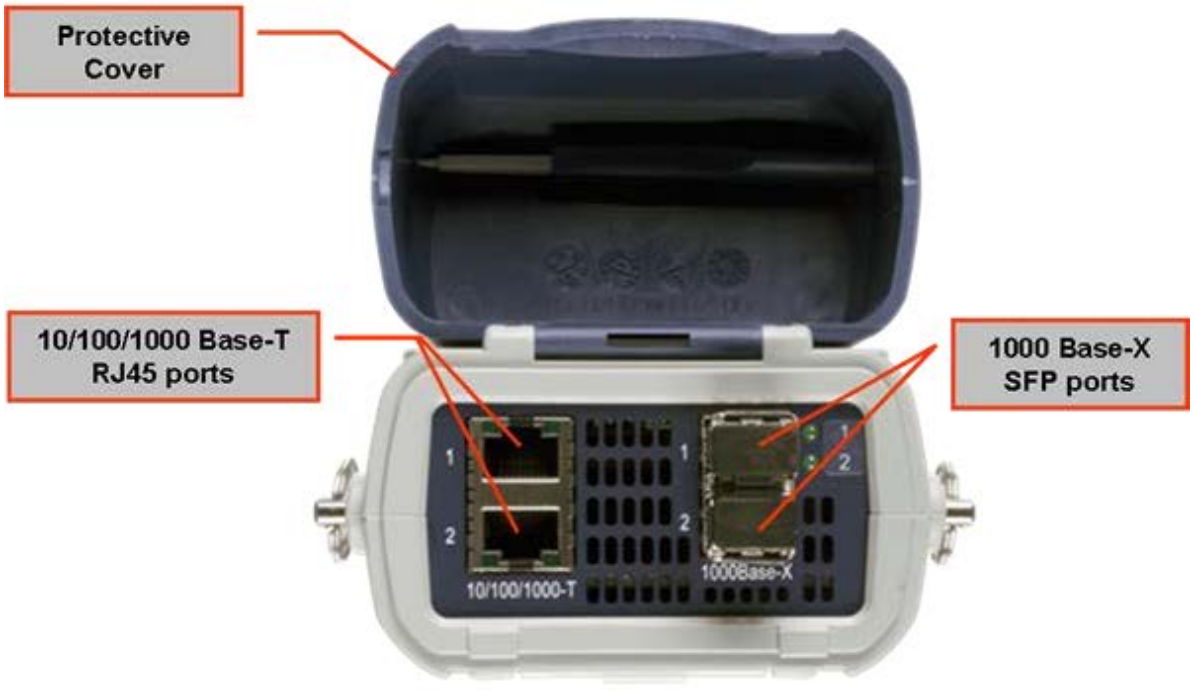
MX120e+ Test Interfaces

The MX120e+ is equipped with the following interfaces:

- **Electrical Ethernet Interfaces**
  - Dual 10/100/1000Base-T Ports, RJ45 connector, IEEE 802.3 compliant
  - A green LED on the RJ45 connector flashes when there is activity on the network
  - The green LED is On when there is a valid Ethernet link with the network and off when there is no link
- **Optical Ethernet Interface options**
  - **Dual 1000Base-X SFP Ports, LC connector**
    - 1000Base-SX (850nm)
    - 1000Base-LX (1300nm)
    - 1000Base-ZX (1550nm)
    - 100Base-FX

Note: Port 2 can only be configured in loopback.

MX120e+ Connector Panel



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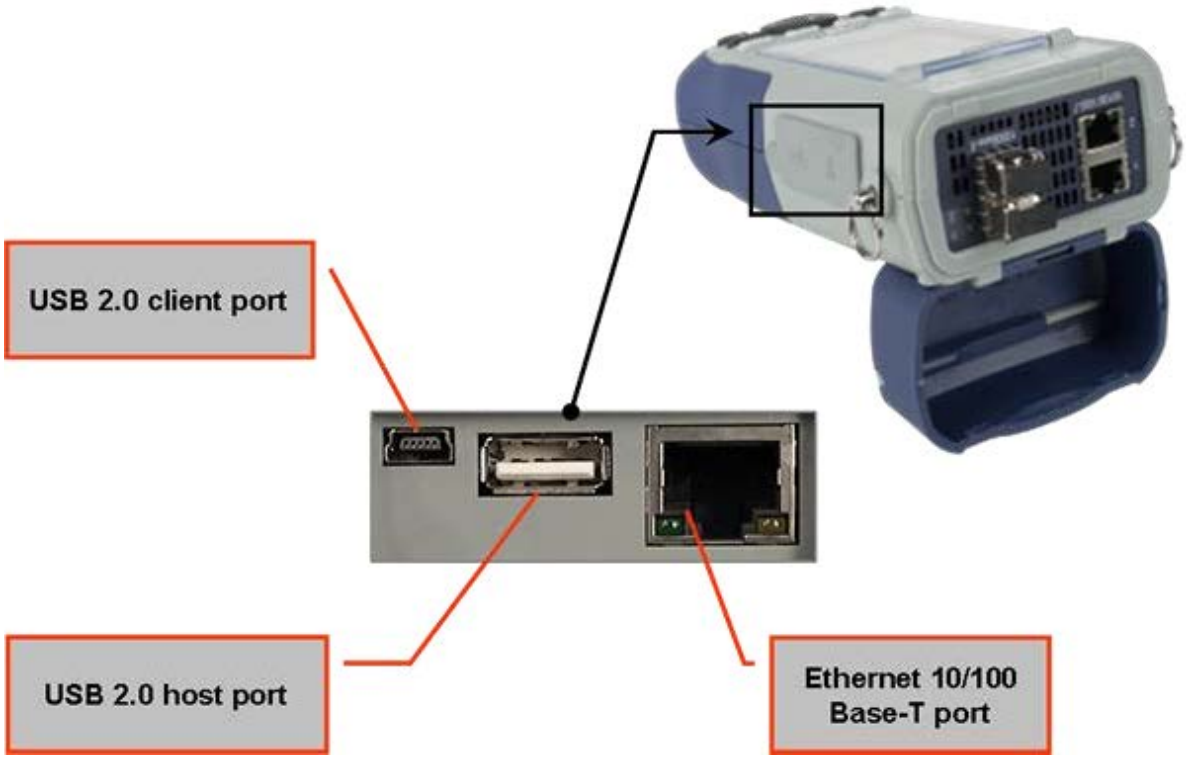
4.4.2 Utility Ports

The Ethernet and USB ports are located on the left and right side of the unit.

- **RJ45, 10/100Base-T port:**
  To access the Ethernet management port, remove the protective rubber cover on the right hand side of the unit to expose the connector. Ethernet applications include:
  - IP connectivity testing
  - Transfer measurement results and test profiles between the instrument and a computer using ReVeal MTX software
  - Upload/download channel tables between the instrument and a computer using ReVeal MTX software
  - Upgrade the instrument software using ReVeal software
  - Remote control of the instrument using ReVeal software (optional)

- **USB Port:**
  To access the USB port, remove the protective rubber cover on the right hand side of the unit to expose the connector. The USB port supports:
  - Memory drives
  - WiFi adaptor for WiFi testing application
  - VoIP Headset



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4.5 LEDs

The MX100e+ and MX120e+ test sets are equipped with the following LEDs:

- **Power LED:** A single LED indicates the power state of the unit
  - The LED is off when the unit is powered off
  - The LED is green when the unit is powered on
  - The LED is orange when the unit is connected to the AC Main and powered off

- **Signal LED:** Indicates presence of a valid input signal
- **Frame LED:** Indicates presence of valid framing on the input signal
- **Pattern LED:** Indicates test pattern synchronization in BERT, RFC, and Throughput modes
- **Alarm/Error LED:** Indicates the presence of alarms or errors

LED Panel

Note: Each LED is equipped with a History function

- **Green LED:** Indicates that no alarm/error has occurred
- **Red LED:** Indicates that at least one alarm/error has occurred during the test
- **Red flashing LED:** Indicates any alarms/errors that have occurred
- **Grey LED:** Indicates inactivity on the Signal, Frame, Pattern or Alarm/Error interfaces

Note: The **History** key on the rubber keyboard resets the soft LEDs on the GUI.

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4.6 Software Upgrade

There are two methods of updating the test set software: manually or via ReVeal MTX software.

Manual Software Upgrade

To manually upgrade the test set software, download the latest version from the VeEX website.

VeEX Inc.
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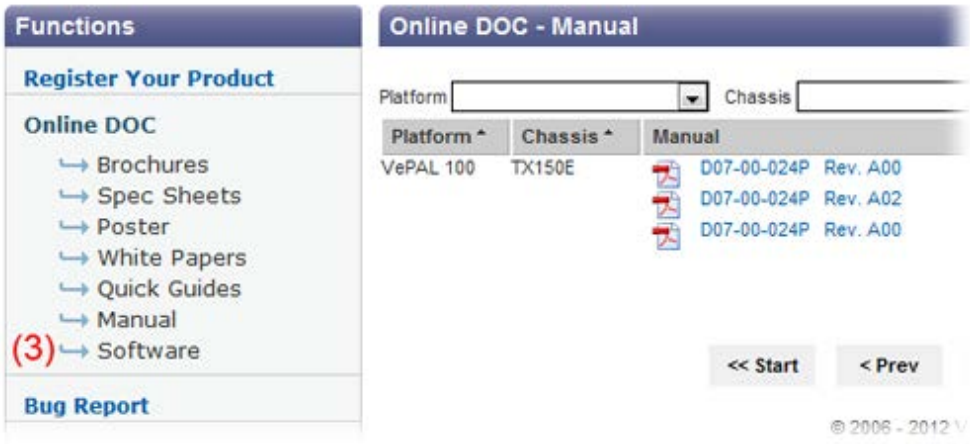
[02.16.2012] VeEX successfully demonstrates interoperability of Mobile Backhaul test solution.
Fremont, Calif., February 16, 2012 – VeEX Inc., a global leader in Telecom and CATV test solutions, recently participated in the multi-vendor Interoperability Showcase organized by the European Advanced Networking Test Center (EANTC). The test event focused on the latest innovations in IPv6 Migration, Mobile Backhaul Transport and Synchronization, MPLS-TP Fault Management, and Performance Monitoring. more...
DOMAIN ORIGINAL CERTIFIED
CLICK TO VERIFY
(1) Partners/Customers Login
Username
Password
Clear
Sign in
Register
Lost my password/username
IEEE 1588v2
PDH
DSn
DS1
Legacy & Synchronized Packet Networks
NEW
Fiber
FX300
FTTx, xPON, Mobile Backhaul, CATV, LAN/WAN
CATV
CX20
Handheld Leakage Detector
Hot & New

Downloading Software from the VeEX website

- Enter Username and Password under **Customers Login** (1).
- Click on the **Customers** tab at the top of the screen after successfully logging in (2).
- Click on **Software**, located in the **Functions** toolbar on the left side of the screen (3). Search for and download the latest MX100e+/MX120e+ software onto the PC.



Installing New MX100e+/MX120e+ software

- Unzip the file and copy the unzipped folder onto a USB stick formatted in the FAT-32 file format.
- Verify that the MX100e+ unit is powered off and that the AC adaptor connected to the unit is charging the battery. Insert the USB stick on the right side of the unit.
- Press and hold the **Save**, **Help** and **Power** keys simultaneously. The unit should boot from the USB and load the new software.
- A message will appear on screen stating the upgrade is in progress. Installing the software will take around 10-15 minutes.

Note: Do not remove the USB memory stick until upgrade is complete. Doing so will interrupt the software upgrade and corrupt the upgrade progress.

Updating with ReVeal MTX

Please refer to **7.4 Upgrade** in the ReVeal MTX manual.

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5.0 Home Menus

The Home menu can be accessed at anytime during operation by pressing the **Home** key on the rubber keypad.

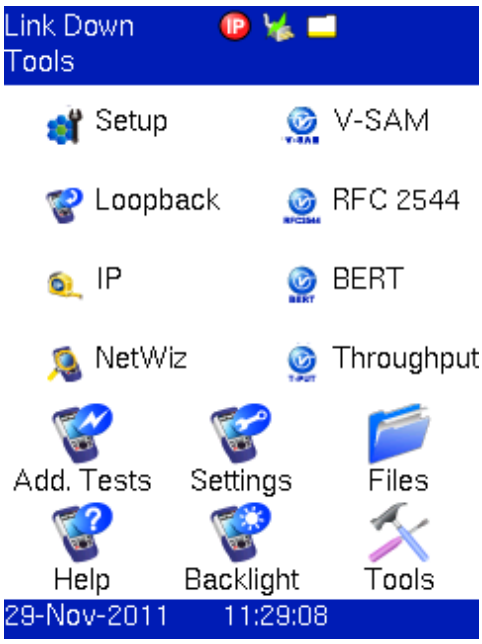
- **Screen Layout**
- **Screen Icons**
- **Action Menu**

5.1 Screen Layout

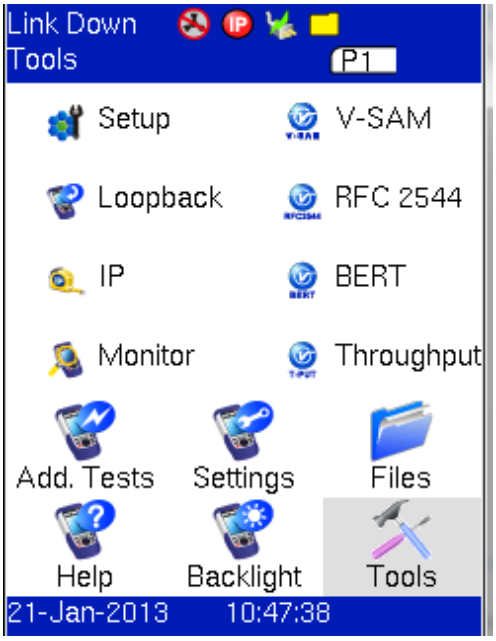
The screen is divided into two presentation areas:

- **Top:**
  - Test Applications specific to the MX100e+ and MX120e+ Port 1:
    - RFC 2544
    - BERT
    - Throughput (OAM)
    - IP functions related to the Ethernet WAN test ports
    - Loopback
    - Port Setup to configure test interfaces
    - Net Wiz
    - Monitor Mode (MX120e+ Port 1 only)
    - V-SAM
  - Test Applications specific to the MX120e+ Port 2:
    - Loopback
    - IP
- **Bottom:**
  - Applications common to all VePAL100+ test sets:
    - Additional Tests
    - Settings
    - Files
    - Help
    - Backlight
    - Tools: IP connection status, Advanced IP features (Net Wiz, WiFi Wiz, VoIP, and IPTV applications)

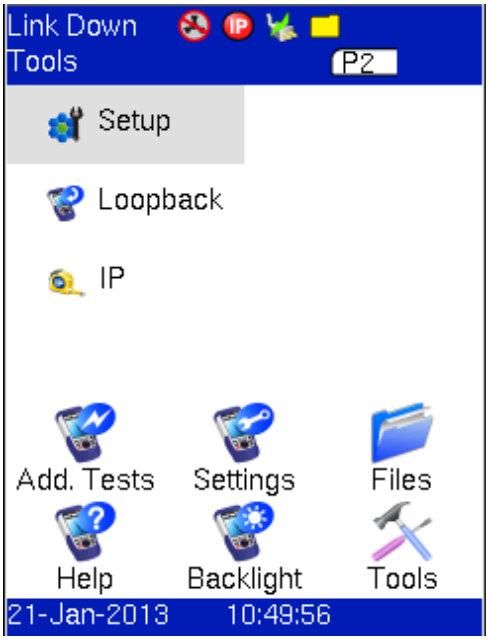
MX100e+ Home Menu



MX120e+ Home Menu for Port 1 (P1)



MX120e+ Home Menu for Port 2 (P2)



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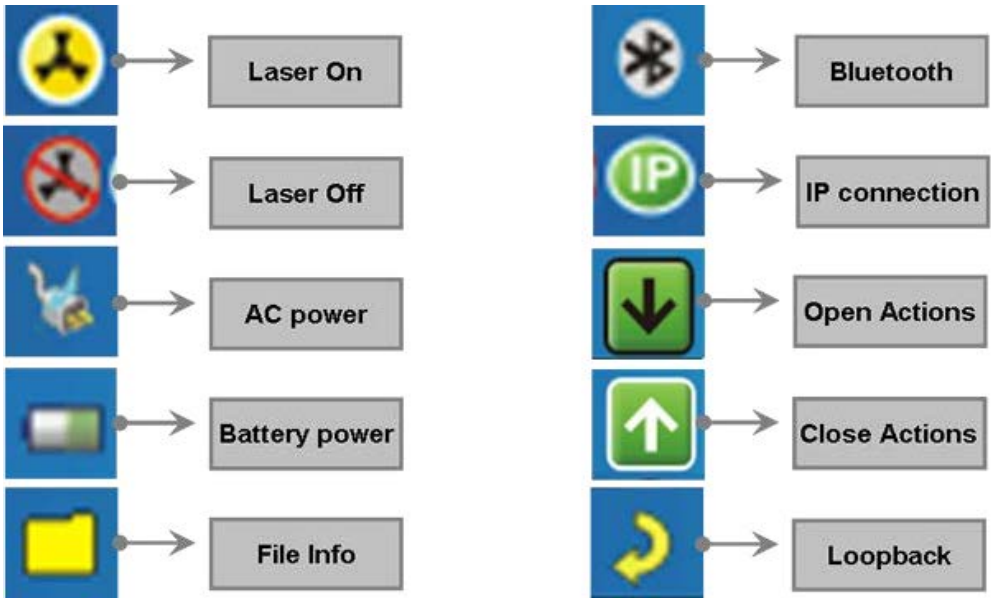
5.2 Screen Icons

The following icons are located at the top right hand corner of the screen:

- **Laser icon:** Indicates if the optical transmitter in the SFP transceiver is switched On or Off.
- **Power icon:** Indicates if the unit is being powered by the internal Li-ion battery or external AC power. If running on battery, tap the icon for battery status.
- **File icon:** Indicates File Storage. Tap icon to view memory capacity used.
- **Bluetooth icon:** Future option (Bluetooth is not supported currently).
- **IP icon:** Indicates status of IP connection on either test or management port. Green indicates a valid IP connection while red indicates no IP connection.
- **Open / Close icon:** Opens or closes drop-down menu and action bar.
- **Loopback icon:** Indicates unit is in loopback mode.

Screen Icons



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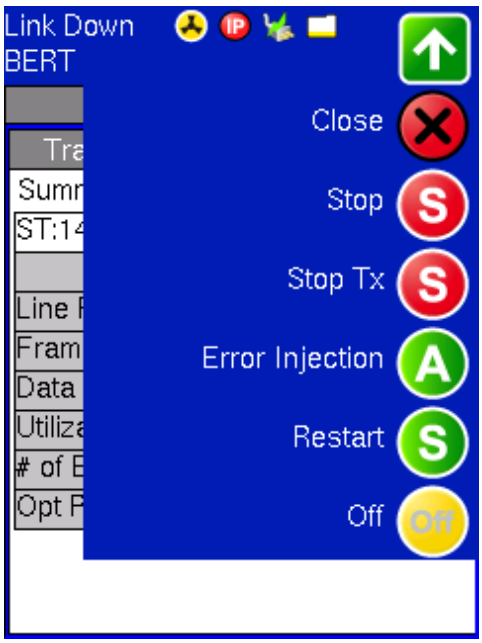
5.3 Action Menu

The Action Menu is accessed by tapping the **Action** icon in BERT or Throughput Testing. Menu options feature:

- **Close:** Closes the Action menu
- **Stop:** Stops the measurement
- **Stop TX:** Stops the Transmitter
- **Error Injection:** Injects an Error or Alarm depending on Error and Alarm generation settings
- **Restart:** Restarts the measurement after it has been stopped by the user
- **Laser On/Off:** Turns Laser On or Off depending on measurement application

Action Menu



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6.0 Setup

Test port(s) and network settings are required prior to performing any measurements or applications.

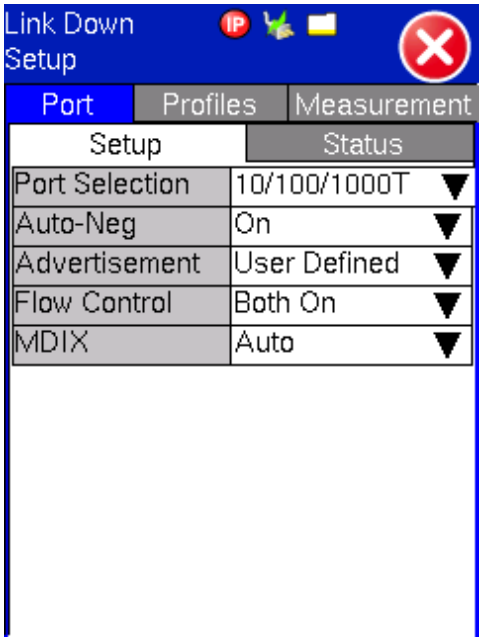
- **Port Setup**
- **Port Status**
- **Laser Activation**
- **Profiles**
- **Measurement Settings**

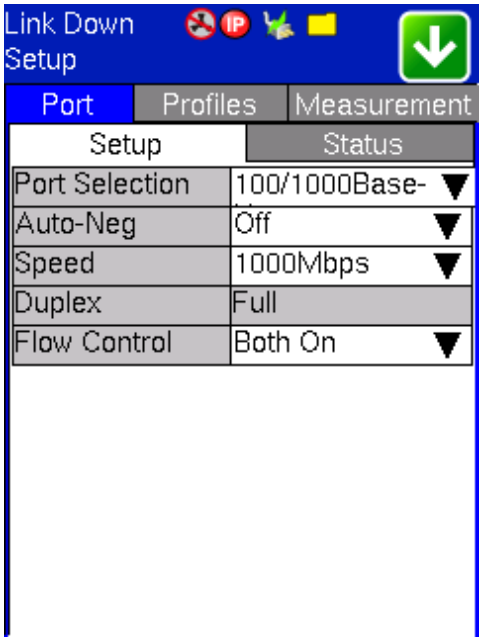
6.1 Port setup

Port setup or the test interface configurations are accessed via the Setup menu located on the Home page. The user selects the operation mode and the interface(s) that will be used to carry out tests.

- **Port Selections:** Differs from MX100e+ to MX120e+
  - **MX100e+ Interface selections:**
    - Single Copper port 10/100/1000Base-T
    - 100Base-FX/1000Base-X
    - Single Fiber port 1000Base-X

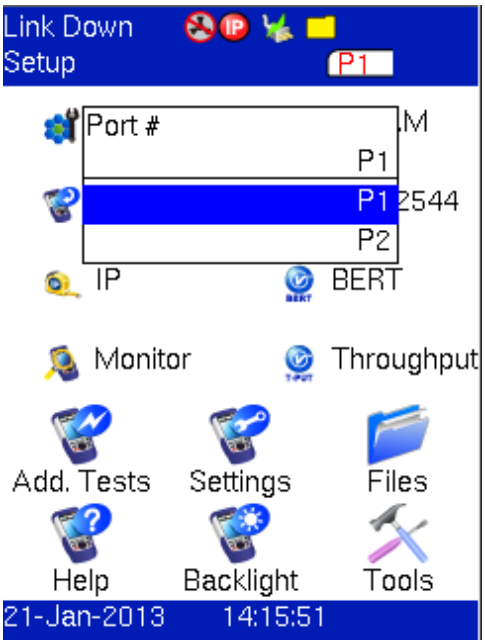
MX100e+ Port Settings - Copper **MX100e+ Port Settings - Fiber**





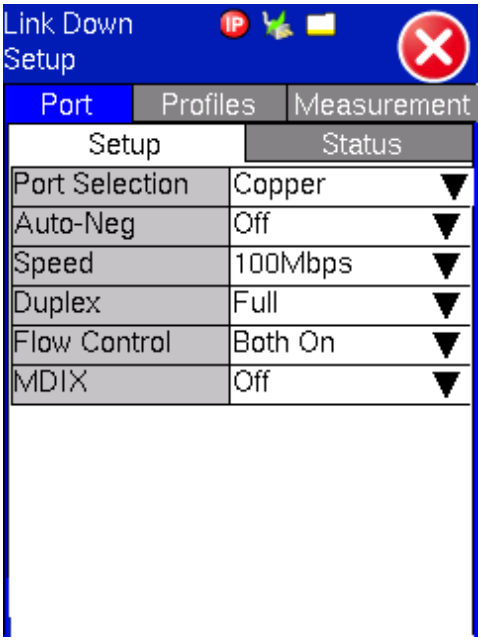
- **MX120e+ Interface selections:**
  - Dual Port is the default selection. The user can switch between Port 1 and Port 2 by selecting P1 or P2. See Chapter 5.0 Home Menus for screenshots and more information on MX120e+ P1 and P2 home menus. Port 2 has limited functionality.

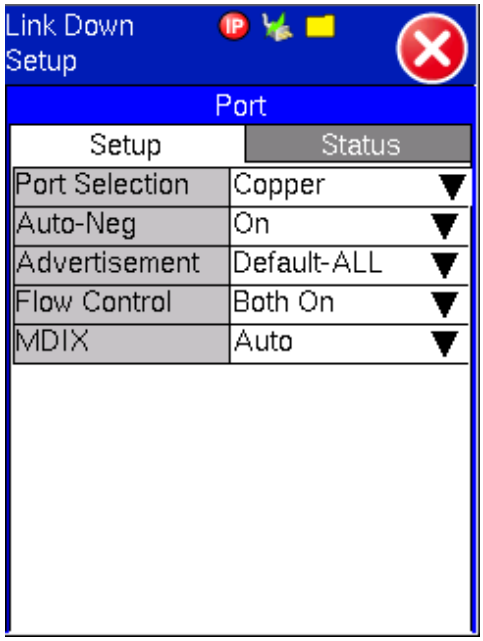
MX120e+ Port Selection



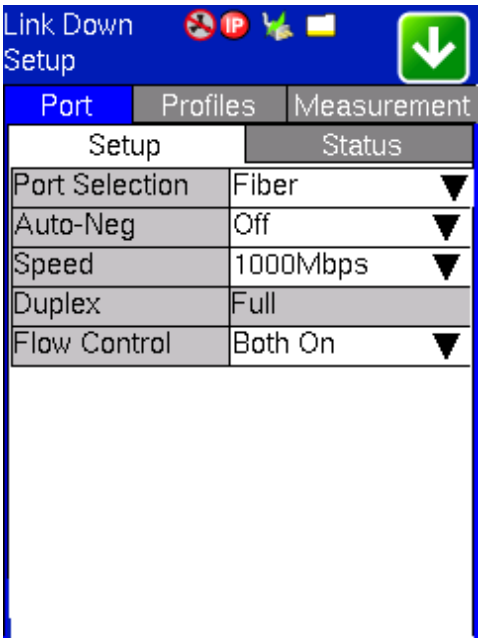
MX120e+ Port Settings - Copper (P1)

MX120e+ Port Settings - Copper (P2)

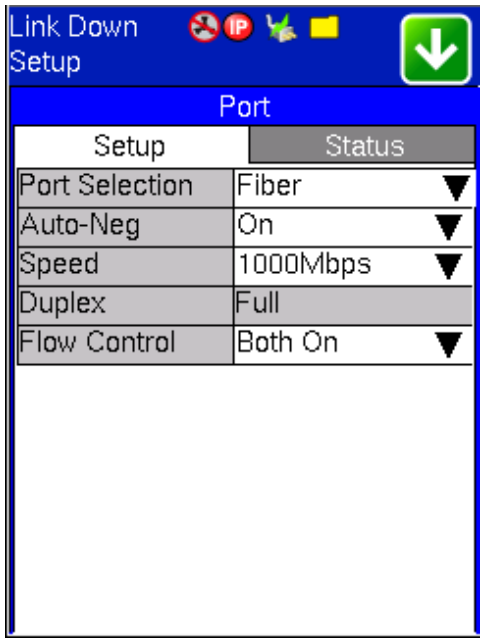




MX120e+ Port Settings - Fiber (P1)



MX120e+ Port Settings - Fiber (P2)

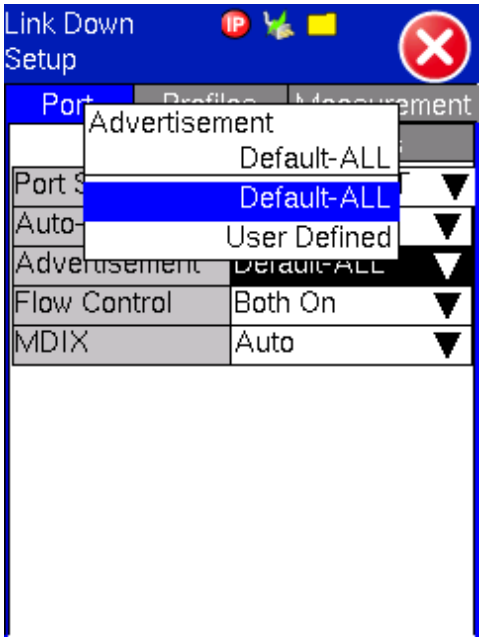


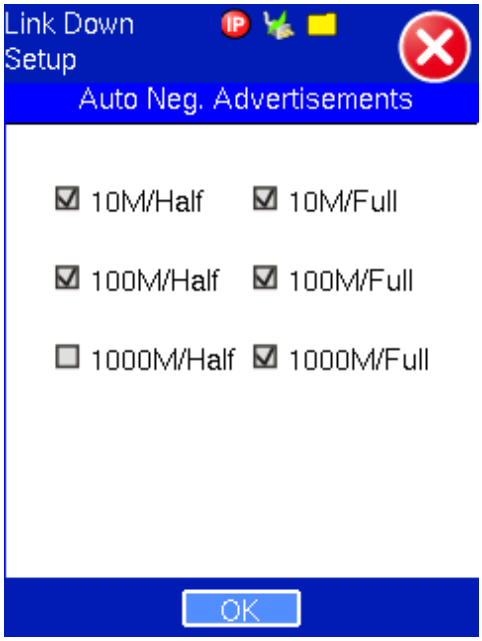
Note: When Dual port mode is selected (MX120+ only), a P1 and P2 selection window appears at the top of the screen. Use this window to select and configure the necessary port settings.

- **Auto Negotiation:** On or Off. Matches the test set's negotiation settings to those of the link partner.
- **Advertisement:** Default-All or User Defined.

Copper Port
Advertisement Selection

Copper Port
User Defined Selections





- **Speed:** Only available when auto-negotiation is off. Select from 10Mbps, 100Mbps, or 1000Mbps when the 10/100/1000T port is selected. 100 Mbps for 100Base-FX. 1000Mbps/1Gbps is fixed when the 1000Base-X port is selected.
- **Duplex:** Only available when auto-negotiation is off for the 10/100/1000T port. Select from half or full duplex modes.
- **Flow control:** On or Off. Once the operating mode and interfaces are selected, the user can independently configure the auto-negotiation, speed, duplex, and flow control settings for each port (where applicable).
  - When flow control is enabled, the test set will respond to pause frames received by the link partner by adjusting the transmit rate.
  - When flow control is disabled, the test set ignores all incoming pause frames from the link partner and continues transmitting at the configured transmit rate.

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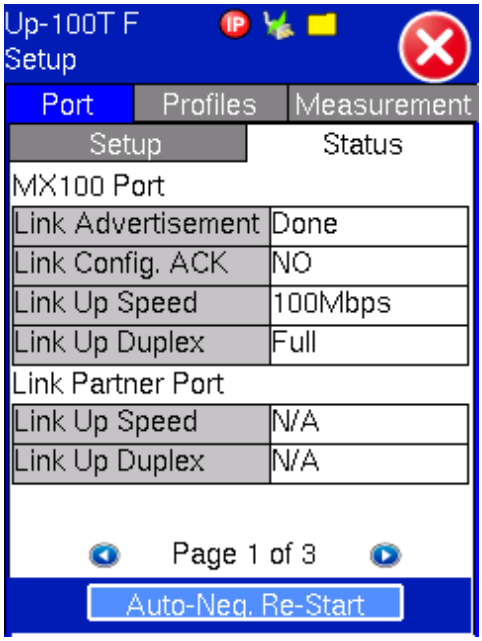
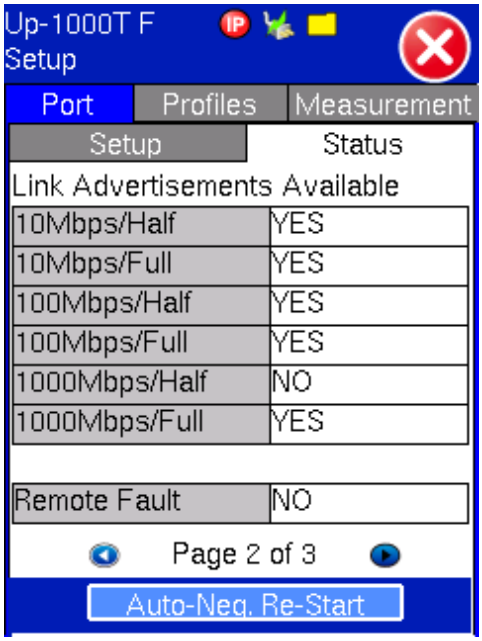
6.2 Port Status

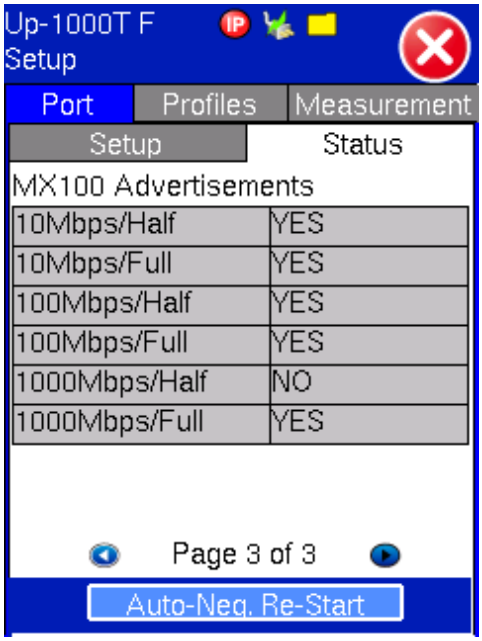
MX100e+ Copper Port Status
Page #1



MX100e+ Copper Port Status
Page #2



MX100e+ Copper Port Status
Page #3



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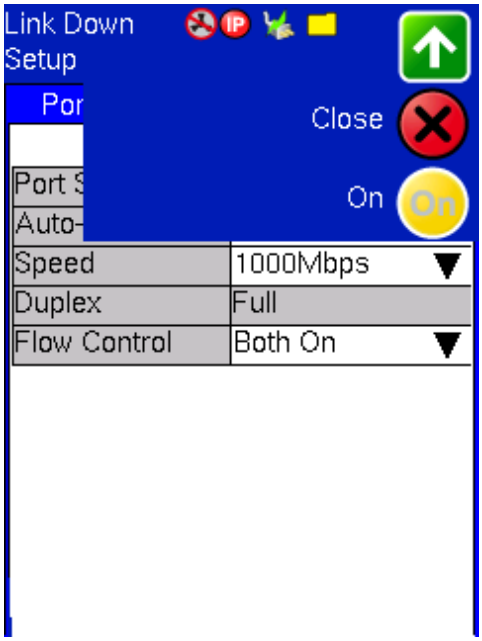
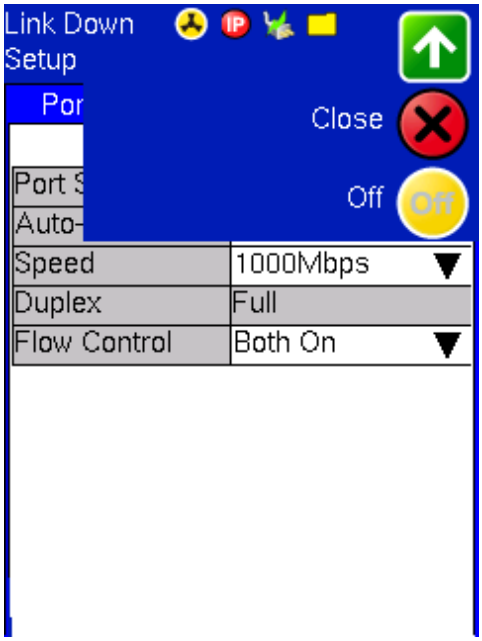
6.3 Laser Activation

- **LASER On/Off Operation:** When the 1000Base-X port(s) is/are selected, the top drop-down menu appears in the Setup/Port screen. From this drop-down menu the user is able turn the LASER On or Off.
  - The LASER may also be turned on/off from any of the following application menus:
    - BERT
    - RFC 2544
    - Throughput
    - V-SAM
    - Loopback
    - IP

Laser Operation - Off



Laser Operation - On



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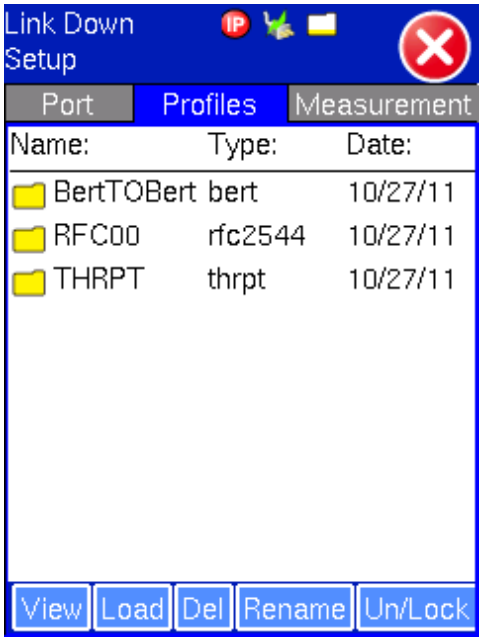
6.4 Profiles

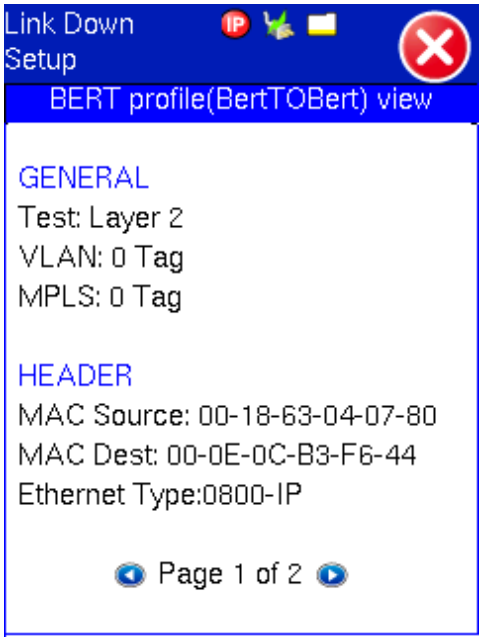
Profiles Tab:

Previously stored profiles can be viewed, deleted and loaded from this screen. When the user loads a profile, the screen will change automatically to the application that the profile corresponds to.

Profile Selection



Profile View



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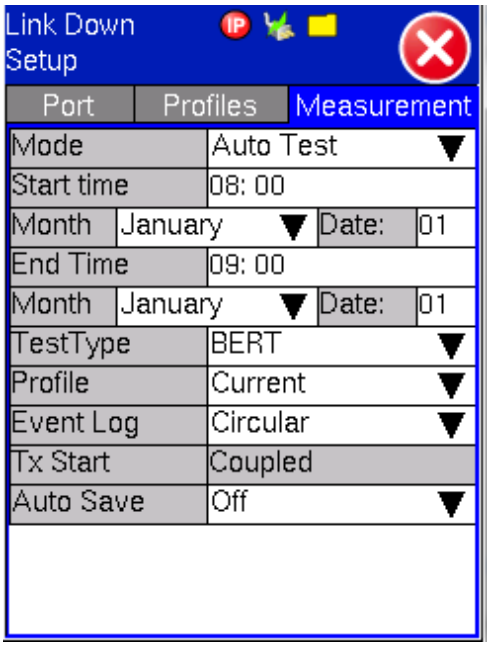
6.5 Measurement Settings

Measurement Tab:

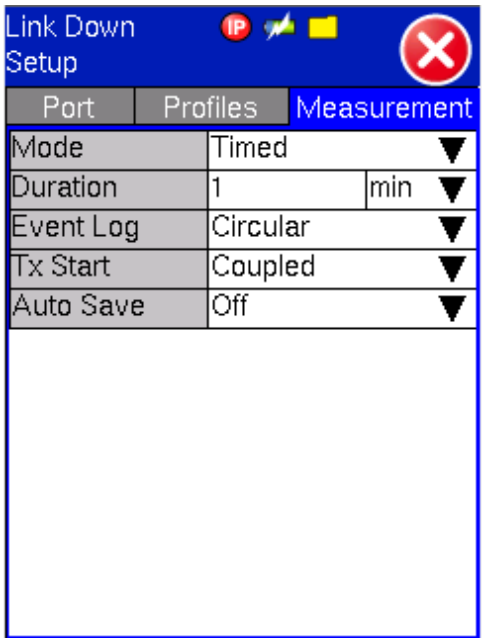
The measurement and event log settings are configured in this screen.

- **Mode:** Manual, timed, or auto mode are available.
  - **Manual mode:** User starts and stops the measurements manually.
  - **Timed mode:** User defines the duration of the test. After the test is started, the test will run for the configured duration and stop automatically.
  - **Auto mode:** User configures the start and end time of the test, selects the type of test to run, and a profile if one has been previously stored. The test set must be powered on to carry out an automatic test.

Measurement Settings - Auto Test

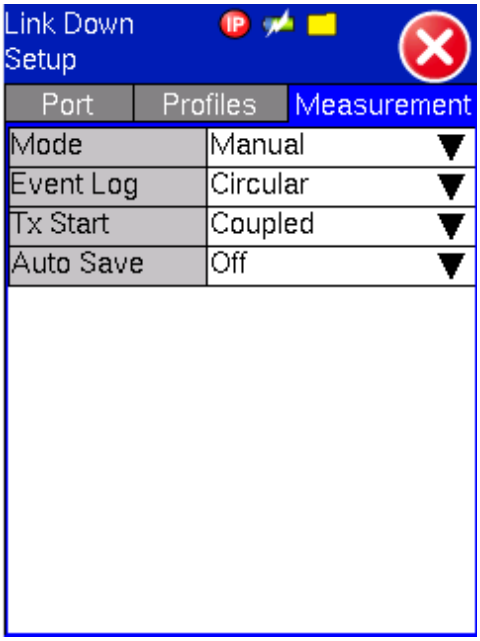


Measurement Settings - Timed



- **Event Log:** Circular or Blocked. Up to 1000 event logs can be stored.
  - **Circular:** Only the latest events will be stored if there are over 1000 event logs. The oldest event will be deleted so that the new event can be added.
  - **Blocked event:** Only the maximum number of events will be stored. Any event that occurs after the 1000th event will not be stored. Event logs consist of a log of the start of test, end of test, errors, alarms, frame loss, etc. The log will have a timestamp, event type, and count (number of errors occurring in that instant).
- **Tx Start:** Tx & Rx (Coupled), or Tx Separate. Configure how the measurements are started when in BERT and Multiple Streams test modes.
  - **Tx & Rx (Coupled):** Transmitter and receiver are turned on at the same time and the Tx and Rx measurements start at the same time at the start of the test.
  - **Tx Separate:** Independent control (Start/Stop) of the transmitter is enabled. At the start of the test only the receiver is turned on - the user must start the transmitter manually.
- **Auto Save:** ON/OFF. When enabled, it saves the results automatically at the end of the measurements.

Measurement Settings - Manual



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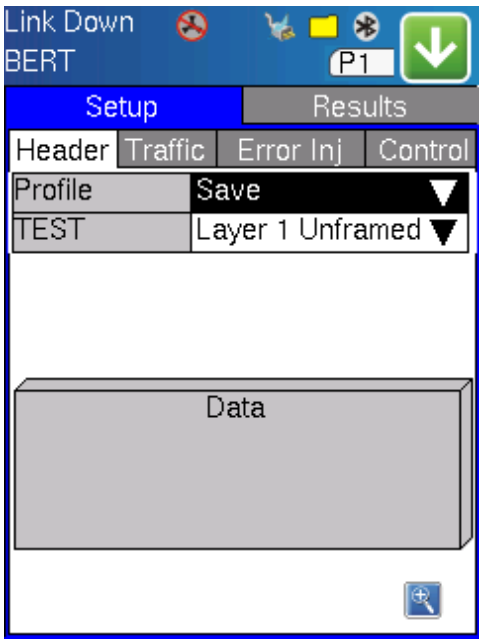
7.0 BERT

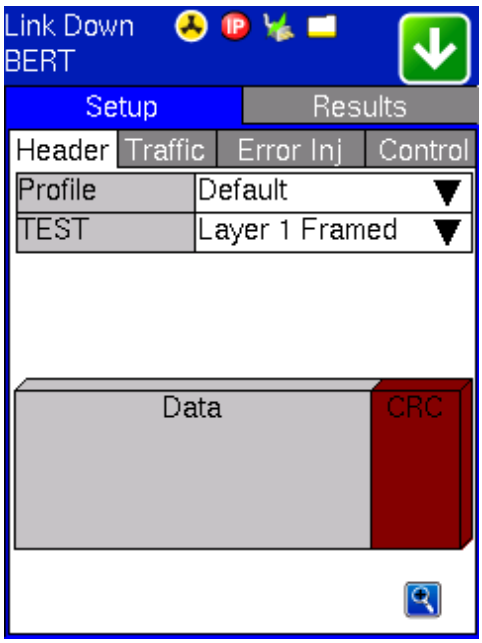
7.1 BERT Setup

Overview:
BER testing at Layer 1, 2, 3, and 4 is supported. The test can be configured to use either regular PRBS patterns, stress patterns or user defined test patterns to simulate various conditions. All patterns are encapsulated into an Ethernet frame to verify bit-per-bit performance of the circuit under test. Prior to testing, the test layer, frame header, traffic profile, error injection, and control settings of the far-end device (if applicable) must be configured.

- **Layer 1:** Unframed mode (fiber ports only) or Framed mode
  - **Unframed mode:** Test traffic consists of a bit stream of the selected test pattern
  - **Framed mode:** Test pattern is encapsulated into a valid Ethernet frame with SOF, Preamble and CRC field

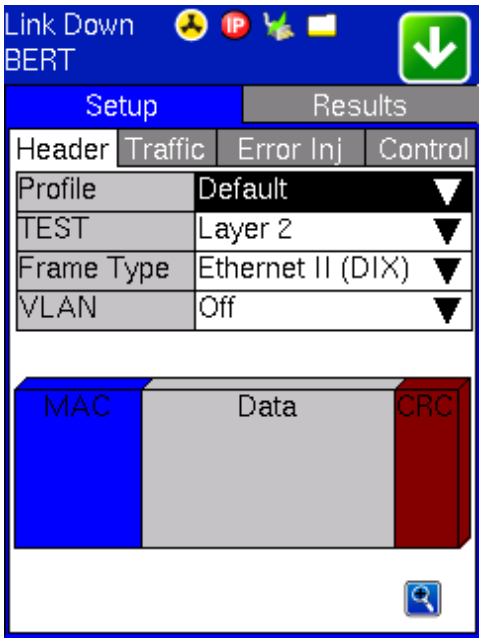
BERT Setup - Header (Layer 1 Unframed) **BERT Setup - Header (Layer 1 Framed)**



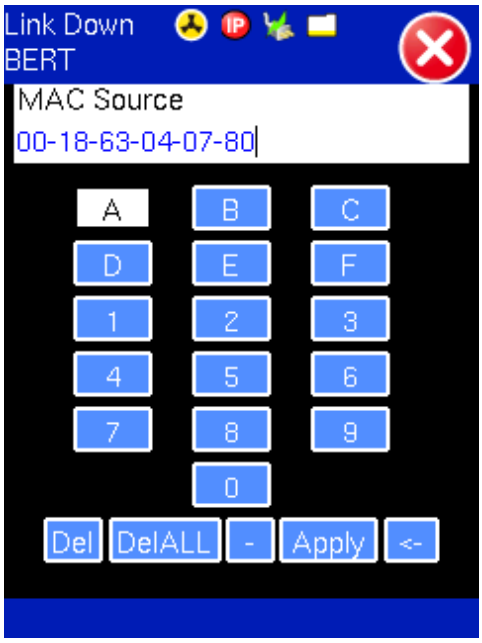


- **Layer 2:** Framed BERT (same as Layer 1 Framed)
  - **MAC Address:** A default or user configured Media Access Control (MAC) address is added to the frame

BERT Setup - Header (Layer 2)



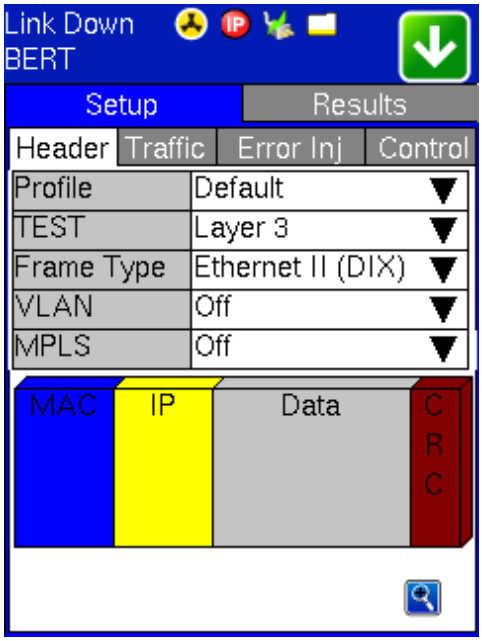
BERT Setup - MAC address editing

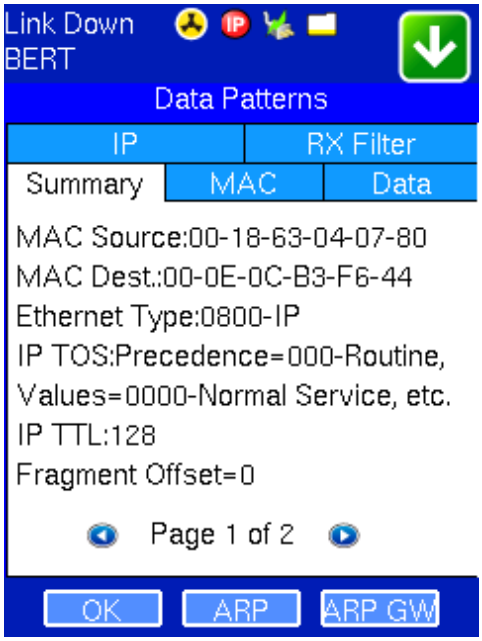


- **Layer 3:** Framed BERT (same as Layer 1 & 2 Framed)
  - **MAC Address:** A default or user configured Media Access Control (MAC) address is added to the frame
  - **IP Address :** A default or user configured IP address is added to the frame

BERT Setup - Header (Layer 3)

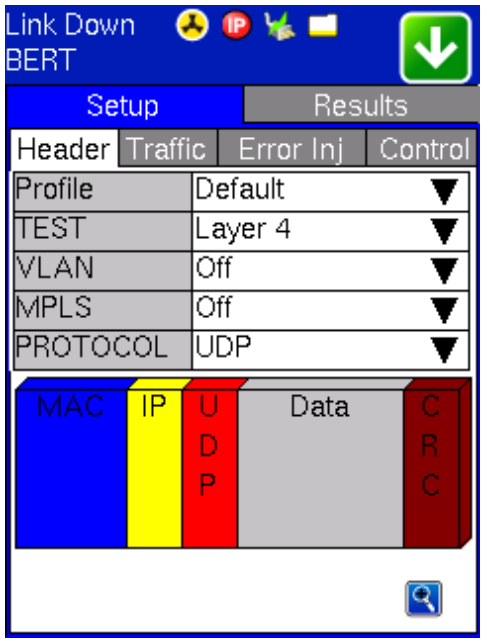
BERT Setup - Header Summary (Layer 3)



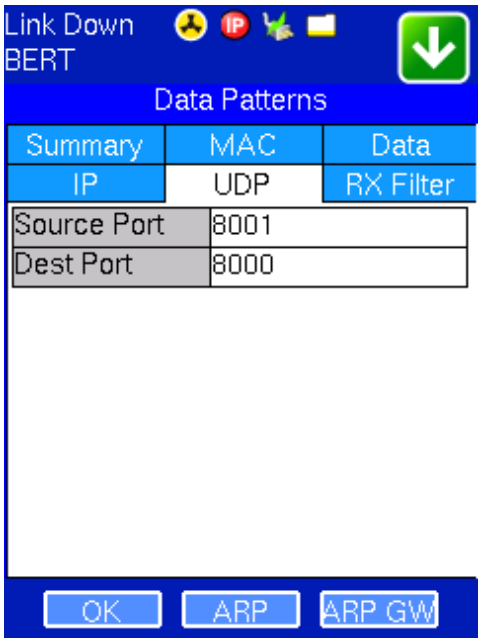


- **Layer 4:** Framed BERT (same as Layer 1, 2 & 3 Framed)
  - **MAC Address:** A default or user configured Media Access Control (MAC) address is added to the frame
  - **IP Address:** A default or user configured IP address is added to the frame
  - **UDP/TCP:** A user defined source and destination port address is added to the frame

BERT Setup - Header (Layer 4)



BERT Setup - Header (Layer 4) UDP Settings



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7.1.1 Header Settings

The test layer, frame header, traffic profile, error injection, and control settings of the far end device (if applicable) must be configured prior to testing.

- **BERT Profile:** Load a previously configured test profile or create a new profile from existing settings
  See Profiles for more details on how to create new profiles

- **Test:** Select the test layer to perform the BERT
  - Options are Layer 1 Unframed, Layer 1 Framed, Layer 2, Layer 3, and Layer 4

- **Frame Type:** Select the Ethernet frame type for Layer 2 or Layer 3
  - 802.3 Raw (IEEE 802.3 frame without LLC) - Not available when Layer 3 is selected

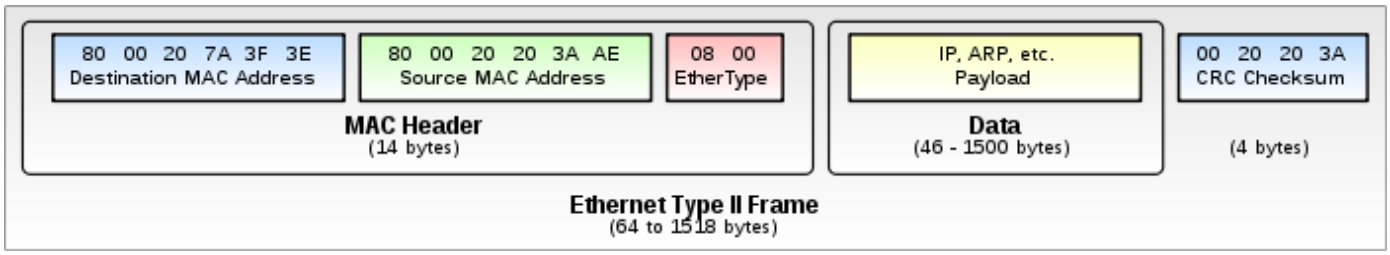
  - 802.3 LLC (IEEE 802.3 frame with LLC header)
  - 802.3 SNAP (IEEE 802.3 frame with SNAP header)
  - Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)

- **MAC/IP:** Tap the MAC and IP blocks on the Frame image to access the setup menus
  - Set the Source and Destination MAC address for Layer 2
  - Set the Source and Destination MAC and IP addresses for Layer 3 and Layer 4

- **VLAN:** Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications)
    Note: VLAN stacking is an option

- **MPLS:** Off, 1 tag, 2 tags, 3 tags
  - The user is able to configure up to 3 MPLS tags
    Note: MPLS tag configuration is only available when the MPLS option is purchased

The most common Ethernet Frame format, Type II



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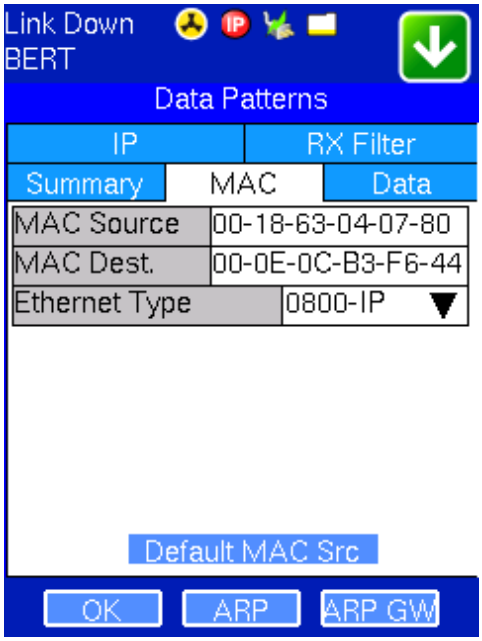
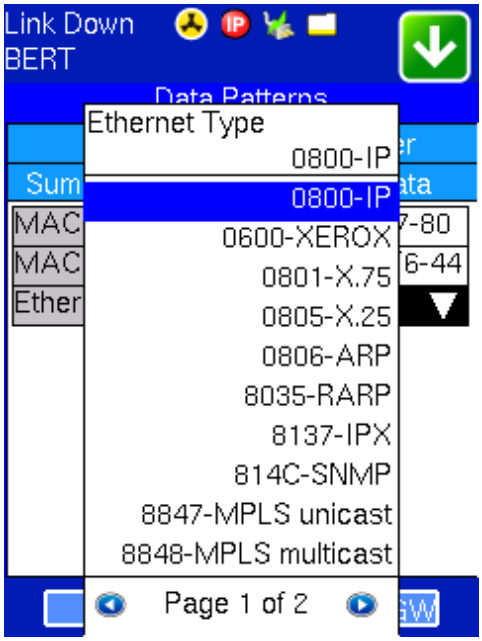
MAC, VLAN, MPLS, IP, and Test Pattern Configurations:

To configure the MAC addresses, IP addresses, VLAN tag(s), MPLS tag(s), and test pattern, tap on the frame image displayed on the screen. This brings you to the configuration screens for all the header fields.

- **MAC Header Tab:**
  - **MAC Source:** Use the default source address of the test set or configure a new or different address.
  - **MAC Destination:** Configure the destination MAC address of the far-end partner test set or use the ARP or ARP GW keys to determine the MAC address of the destination IP address (ARP) or the Gateway (ARP GW). Note that a valid IP connection needs to be up to use these functions. Refer to section **5.1 IP** in the **V100+ Common Functions manual** for details on IP connection.
  - **Ethernet Type:** For Layer 3 and 4 testing, the user can also configure the Ethertype:
    - 0800-IP (Internet Protocol Version 4, IPv4)
    - 0600-Xerox
    - 0801-X.75 (X.75 Internet)
    - 0805-X.25 (X.25 Level 3)
    - 0806-ARP (Address Resolution Protocol [ARP])
    - 8035-RARP (Reverse Address Resolution Protocol [RARP])
    - 8137-IPX (Novell IPX)
    - 814C-SNMP
    - 8847-MPLS unicast
    - 8848-MPLS multicast
    - 86DD (Internet Protocol, Version 6 [IPv6]) - Future Release

BERT Setup - MAC Address Settings (Layer 3) **BERT Setup - Ethertype Settings (Layer 3)**





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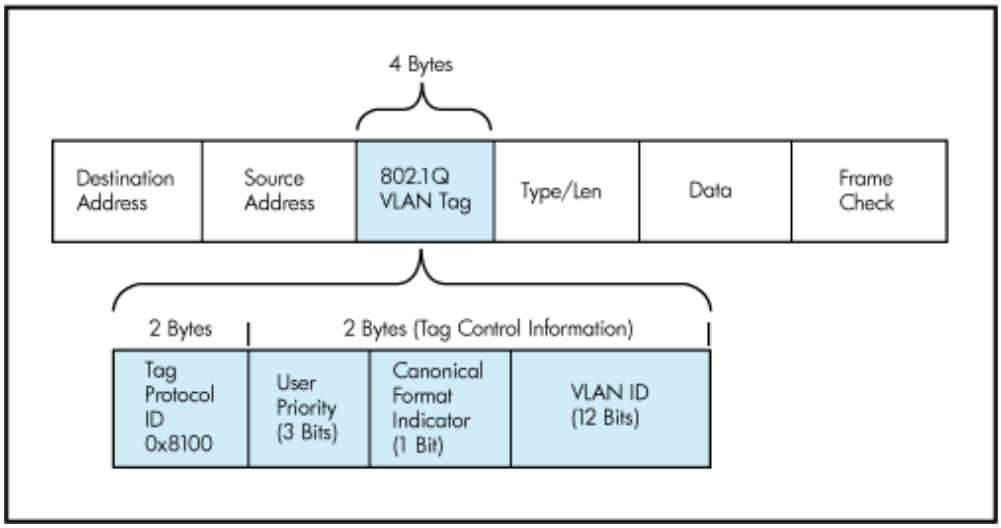
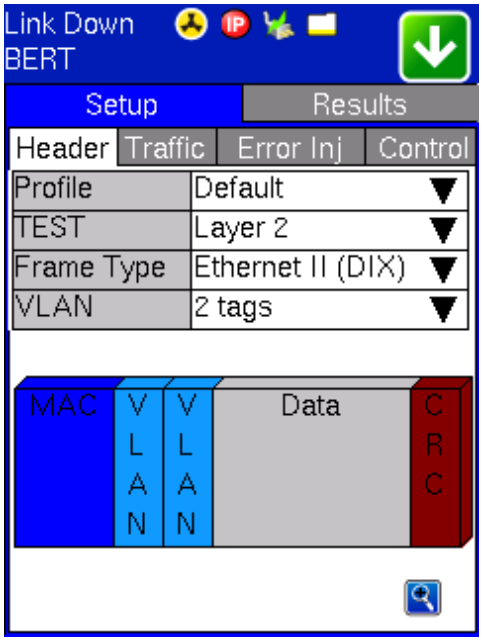
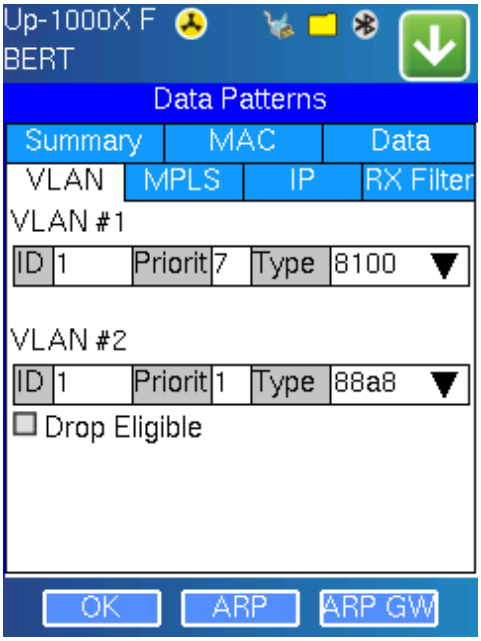
- **VLAN Tab:** In the VLAN tab the following parameters are configured:
  - **VLAN ID:** Can be configured in the range 1 to 4094.
    - VLAN ID is the identification of the VLAN, which is basically used by the standard 802.1Q.
    - It has 12 bits which allows the identification of 4096 (2^12) VLANs.
    - Of the 4096 possible VIDs, a VID of 0 is used to identify priority frames and value 4095 (FFF) is reserved.
    - Maximum possible VLAN configurations are therefore set to 4094.
  - **VLAN Priority:** Can be configured in the range 0 to 7.
    - Set by the Priority Code Point (PCP), a 3-bit field which refers to the IEEE 802.1p priority.
    - It indicates the frame priority level from 0 (lowest) to 7 (highest), which can be used to prioritize different classes of traffic (voice, video, data, etc.).
  - **Type:** The following selections are possible:
    - 8100 (IEEE 802.1Q tagged frame)
    - 88a8 (IEEE 802.1ad Provider Bridging)
  - **Drop Eligible:** If enabled, drop eligibility flag will be set.
  - **VLAN Flooding:** Enable/Disable.
  - **VLAN Flooding Range:** Specifies the number of VLAN IDs. Enter a number from 0-4096. The VLAN IDs will be incremented by 1 until it reaches the number of times entered in the flood range.

IEEE 802.1Q VLAN Tag in an Ethernet Frame



BERT Setup - VLAN Tag Configuration **BERT Setup - VLAN Tag Summary**





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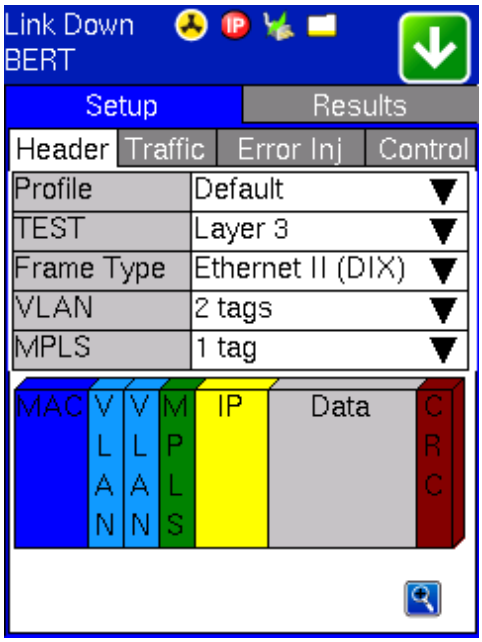
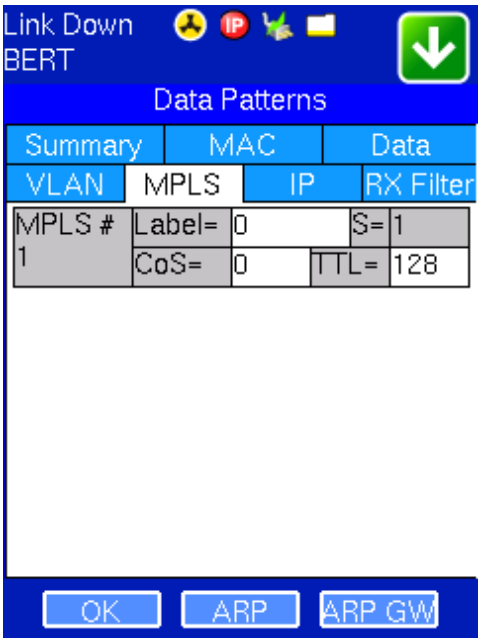
- **MPLS Tab:** In the MPLS tab the following parameters are configured:
  - **MPLS label:** Can be configured in the range 16 through 1,048,575 (labels 0 to 15 are reserved).
    Note: Composed of 20 bits which allows for the creation of over one million labels.
  - **CoS:** Can be configured in the range 0 to 7.
    Note: This field is three bits in length and maps directly to IP Precedence TOS bits to provide Class of Service (COS).
  - **S-bit:** Can be configured 0 or 1.
    Note: The S field is one bit in length and is used for stacking labels. This is important as it is used to indicate the last label in the label stack.
  - **TTL:** Can be configured in the range 0 to 255. The default setting is 128 hops.
    Note: Used to decrement the time-to-live counter.

BERT Setup - Header with MPLS Label



BERT Setup - MPLS Label Summary



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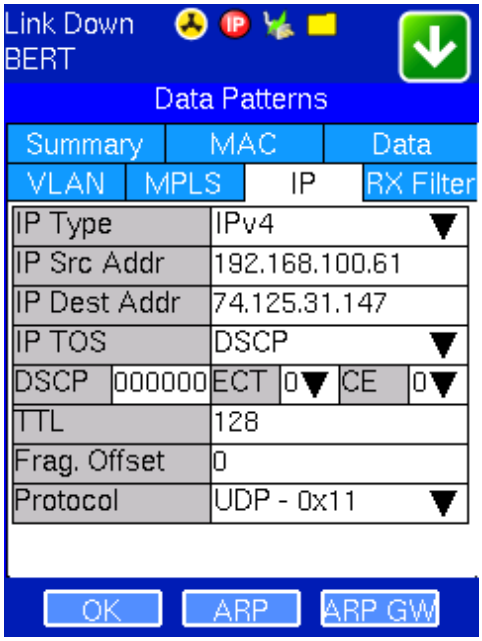
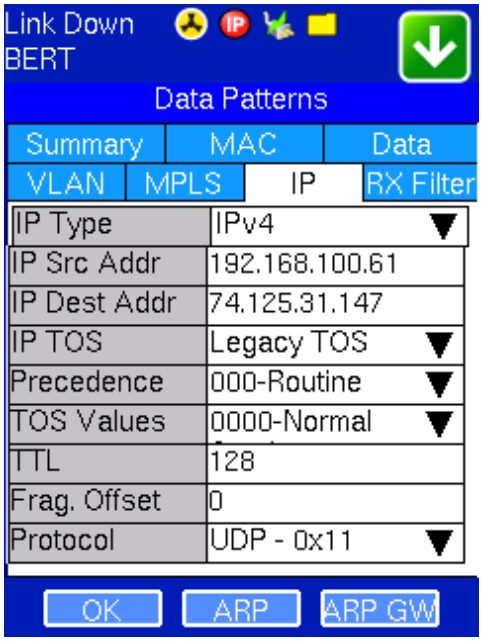
- **IP Tab:** In the IP tab the user must configure the destination IP address and source address. The user may also configure the following IP header fields:
  - **IP Type:** IPv4

- **IP Src and IP Dest:** For IP Src, if the IP connection is up, refer to section **5.1 IP** in the **V100+ Common Functions manual**. The source address is fixed to the IP address from the IP setup menu.
- **IP TOS (for Quality of Service testing):**
  - **Legacy TOS (Precedence):** The first three bits of the IP TOS field can be edited:
    000 - Routine
    001 - Priority
    010 - Immediate
    011 - Flash
    100 - Flash Override
    101 - Critical
    110 - Internetwork Control
    111 - Network Control
  - **DSCP (Differentiated Services Code Point):** The first six bits of the IP TOS can be edited to provide more granular service classification.
    For more information on the definition of DSCP field in IPv4 and IPv6 headers, refer to RFC2474.
  - **Time To Live (TTL):** Can be configured in the range 0 to 255.
  - **Fragment offset byte:** Can be configured in the range 0 to 65.528.
    Note: The fragment offset field, measured in units of eight-byte blocks, is 13 bits long and specifies the offset of a particular fragment relative to the beginning of the original unfragmented IP datagram.
  - **Protocol field:** UDP (0x11), TCP (0x06), or User defined.

BERT Setup - IP Settings (DSCP)



BERT Setup - IP Settings (Legacy TOS)



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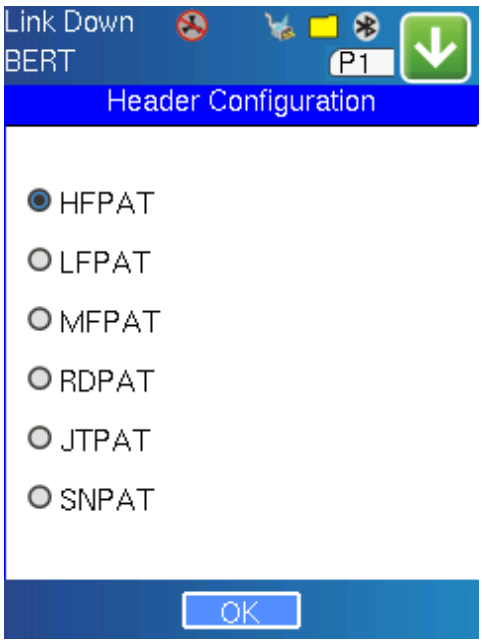
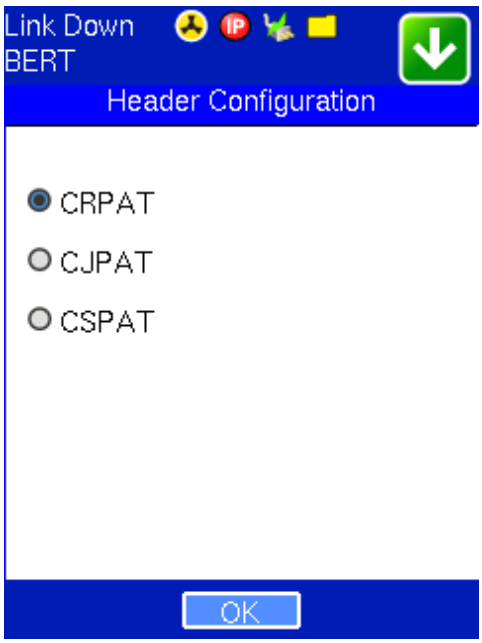
- **Data Tab:** User selects a test pattern that will be encapsulated in the Ethernet frame payload (for framed mode). Depending on the test layer, different test pattern options are available:
  - **Layer 1 test patterns**
    - **CRPAT:** Compliant Random Pattern provides broad spectral content and minimal peaking for the measurement of jitter at component or system level.
    - **CJTPAT:** Compliant Jitter Test Pattern is a Jitter Tolerance Pattern that stresses a receiver by exposing it to extreme phase jumps thereby stressing the Clock Data Recovery (CDR) circuitry. The pattern alternates between repeating low transition density patterns and repeating high transition density patterns.
    - **CSPAT:** Compliant Supply Noise Pattern. Represents worst case power supply noise.

BERT Setup - Test Pattern (Layer 1 Unframed)

BERT Setup - Test Pattern (Layer 1 Framed)





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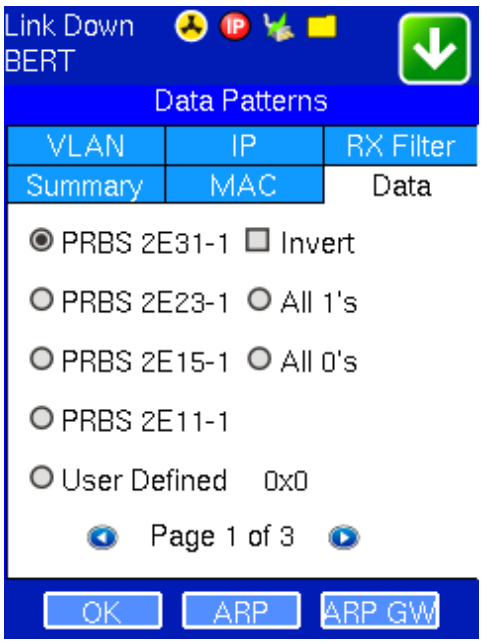
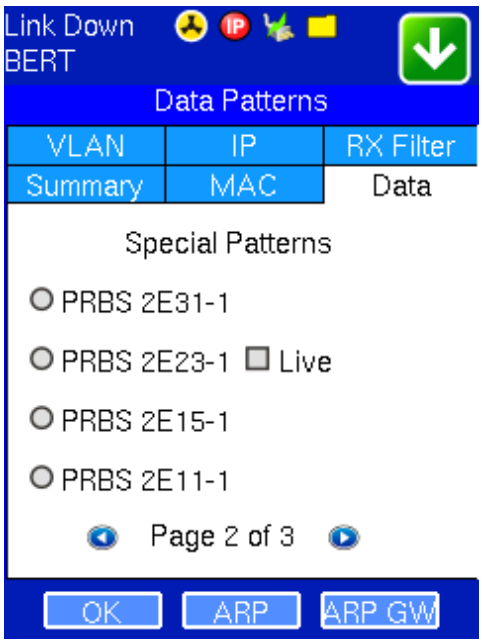
- **Layer 2,3, & 4 test patterns**
  - **PRBS:**
    - 2^31 -1 (147 483 647-bit pattern used for special measurement tasks, e.g., delay measurements at higher bit rates)
    - 2^23 -1 (8 388 607-bit pattern primarily intended for error and jitter measurements at bit rates of 34 368 and 139 264kbit/s)
    - 2^15 -1 (32 767-bit pattern primarily intended for error and jitter measurements at bit rates of 1544, 2048, 6312, 8448, 32 064 and 44 736kbit/s)
    - 2^11 -1 (2047-bit pattern primarily intended for error and jitter measurements on circuits operating at bit rates of 64kbit/s and N x 64kbit/s)
  - **Fixed:** All 0s or All 1s
  - **User Defined pattern:** Length depends on frame size
  - **Inversion:** Normal or inverted

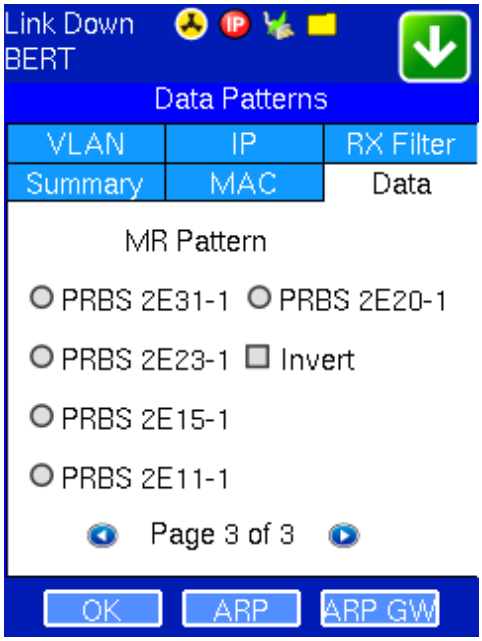
BERT Setup - PRBS Patterns (Page 1)



BERT Setup - Special Patterns (Page 2)



BERT Setup - MR Pattern (MX100e+ only) (Page 3)



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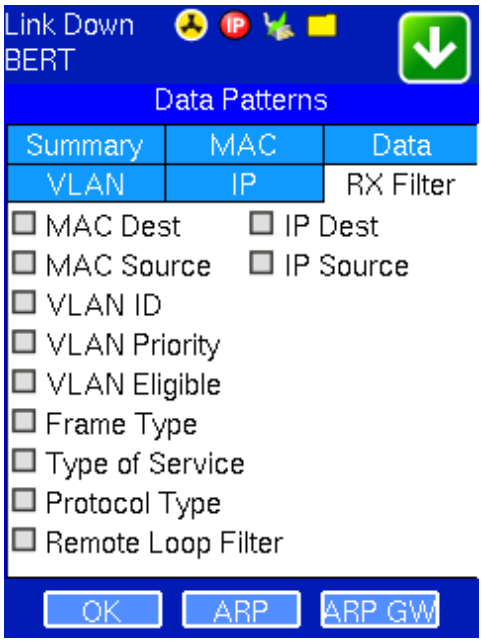
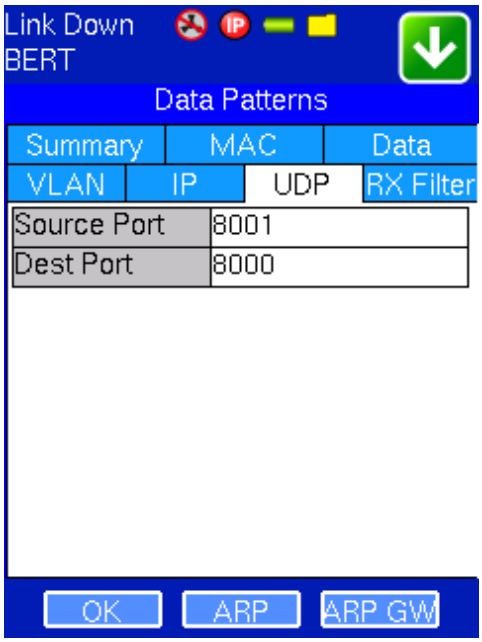
- **RX Filter Tab:** Allows the user to filter incoming streams. When checked, the incoming traffic flows not matching these criteria will not be considered for these results.
  - MAC Destination address
  - MAC Source address
  - VLAN ID
  - IP Destination address
  - IP Source address
  - Remote Loop Filter: When enabled, the remote loop filter will send the Rx filter parameters to the remote loopback unit as part of the loop up command. This way, only traffic corresponding to the filters will be looped and other network traffic will be ignored.

BERT Setup - RX Filter Selection



BERT Setup - UDP/TCP



- **UDP/TCP:** Input Source Port and Destination Port.

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7.1.2 Traffic Settings

Traffic tab:

The user configures the traffic profile for the stream, including traffic flow, frame size, frame type, and transmit rate.

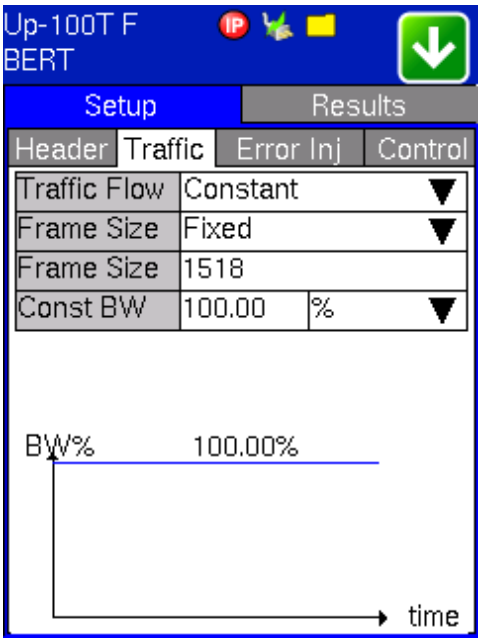
- **Traffic Flow:** Select from the following traffic flows:
  - **Constant:** The selected frame is transmitted continuously according to the selected bandwidth %.
  - **Burst:** The selected frame is transmitted in a staircase profile according to user selectable step time, number of steps, and maximum bandwidth.
  - **Ramp:** The selected frame is transmitted at maximum bandwidth according to the selected duty cycle and burst period.
  - **Single Burst:** Configure the number of frames to be transmitted in the burst along with the bandwidth. For example, if 100000 frames are transmitted at 12.5% of bandwidth, on a 1Gbps line, 100000 frames will transmit at a rate of 125Mbps and then the burst will stop.

- **Frame Size:** Fixed or Uniform min and max frame length values. Uniform traffic is traffic generated with a uniform distribution of frame lengths.

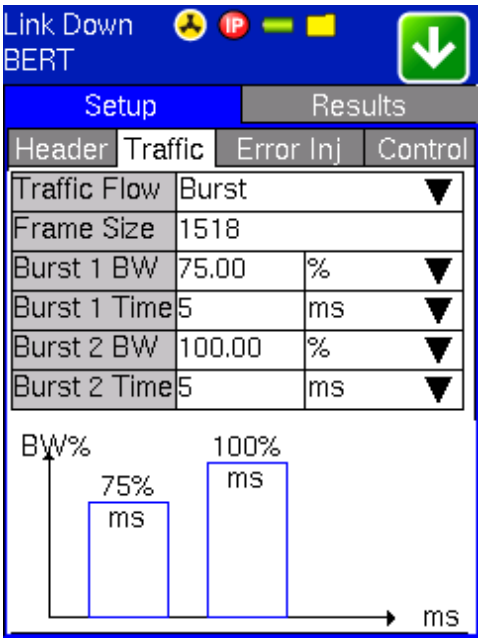
- **Frame Size:** Enter the frame size when a Layer 2, Layer 3, or Layer 4 BERT is selected.
  - Frame size configuration is not available for Layer 1 BERT.
  - Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 10000 bytes.

- **BW (Transmit Bandwidth):** Configure the transmit rate for the test.
  - When traffic flow is equal to Burst, two burst bandwidths are configured with burst time.
  - When traffic flow is equal to Ramp, starting and an ending bandwidth are configured along with the bandwidth step size and duration.
  - Single Burst

BERT Setup - Layer 1 Constant Traffic



BERT Setup - Layer 2 & 3 Burst Traffic



Frame Size Limitations

Layer 1 framed mode - Frame size configuration is not available.
Layer 1 unframed mode - Traffic profile is constant at 100% bandwidth.

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7.1.3 Error Injection Settings

Error injection can only be performed during testing. The error type and injection rate are configured in the Error Injection tab.

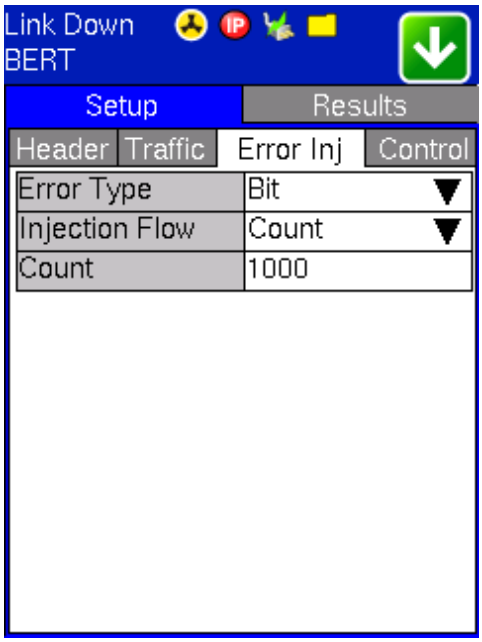
- **Error type:** Select from Bit, CRC, IP Checksum (Layer 3, 4 only), Pause, TCP/UDP Checksum (Layer 4 only). With Pause selected, the unit will transmit a pause frame when **Error Injection** icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.

- **Injection Flow:** Determines how the selected errors will be injected.
  - Select a single error injection or specific count.

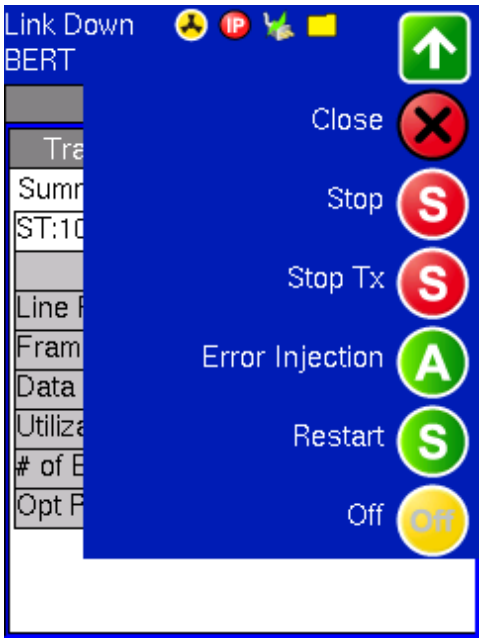
- **Count:** Configures the error count via the numeric pop-up keypad.

Once the test is running, error injection is enabled by selecting the **Error Injection** icon from the action drop-down menu at the top of the screen. Press the **Error Injection** button to inject errors at the predetermined settings.

BERT - Error Injection Setup



BERT - Error Injection Action Menu



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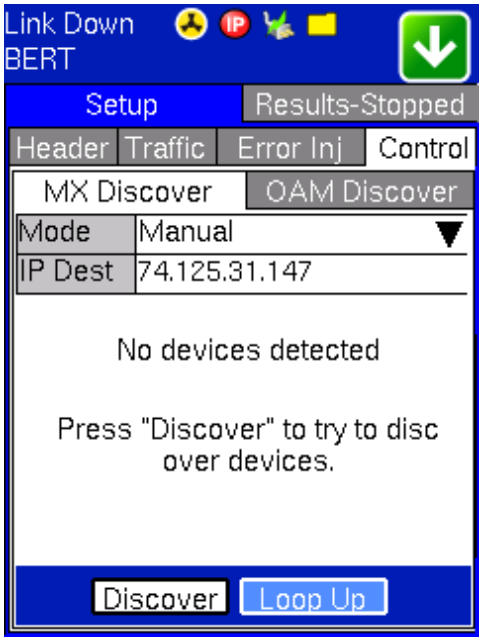
7.1.4 Control Settings

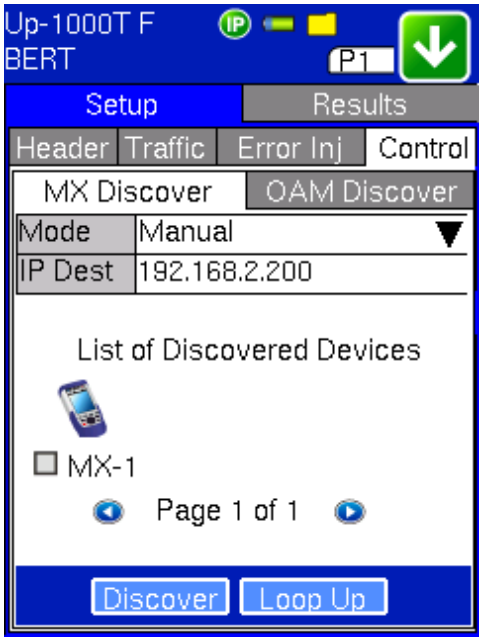
In the Control settings tab, the user configures the loop up and loop down commands necessary to control a far-end unit. The loop up command contains information about the test layer. Looping back test traffic is possible as follows:

- **Layer 1:** All incoming traffic is looped back unchanged.
- **Layer 2:** All incoming unicast traffic is looped back with the MAC source and destination addresses swapped.
- **Layers 3 & 4:** All incoming unicast traffic is looped back with MAC and IP source and destination addresses swapped.

- **Mode:** Manual
  - **Manual:** User must input the destination IP address of the far-end device along with the type of command or press Discover.
    - IP Destination: Enter the IP address of the far-end test set that is to be looped up/down.
    - Prior to starting the test, manually send the loop up command by pressing the Loop Up button.
    - A "Loop up successful" message will appear.
    - After completing the test, manually send a loop down command by pressing the Loop Down button.

BERT - Control Setup (Manual) **BERT - Device Discovery**





MX Discover Feature

If the local and remote test sets are on the same IP subnet, the MX Discover feature can be used to:
- Automatically discover the far-end test unit by pressing the Discover button
- Once discovered, select the remote unit and send a loop up command
- No manual configuration of the IP address is needed, since these are populated automatically

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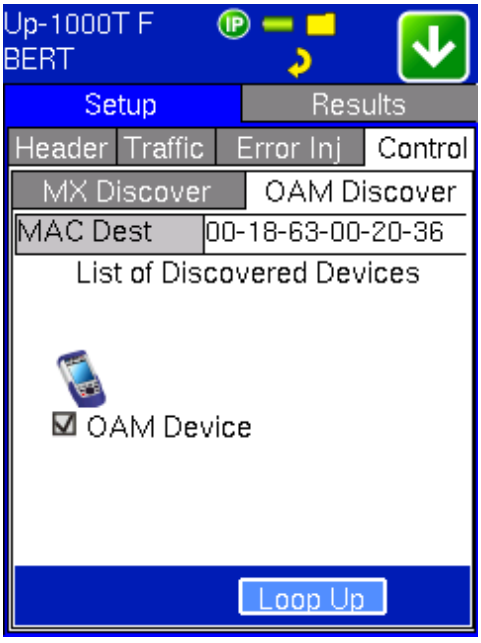
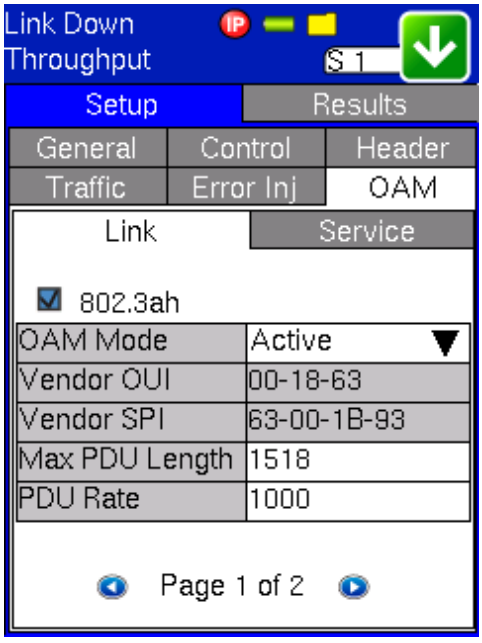
BERT - Control Setup - OAM Discover



Link OAM



OAM Discover

Like MX Discover, OAM Discover can also be used to discover far-end test units without manually configuring the remote unit's destination address. To discover the remote unit's MAC address:

- Go to **Throughput** > **OAM** > **Link** and tap on the 802.3ah check box to enable Link OAM. Select Active from the **OAM Mode** drop-down menu (only Active mode can send loop commands).
- Return to the BERT OAM Discover tab to see a list of discovered OAM devices. Select an OAM device and press **Loop Up** to send a loop up command to the selected remote unit.

OAM Devices

If OAM is enabled, any link partner that supports the IEEE 802.3ah protocol, will be discovered automatically and be displayed under the **OAM Discover** tab.

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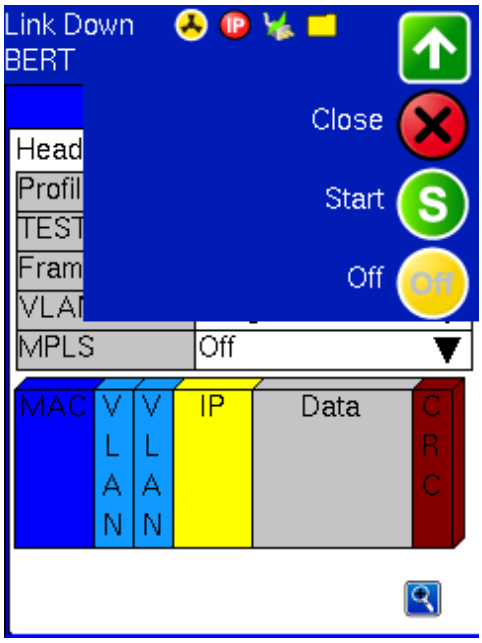
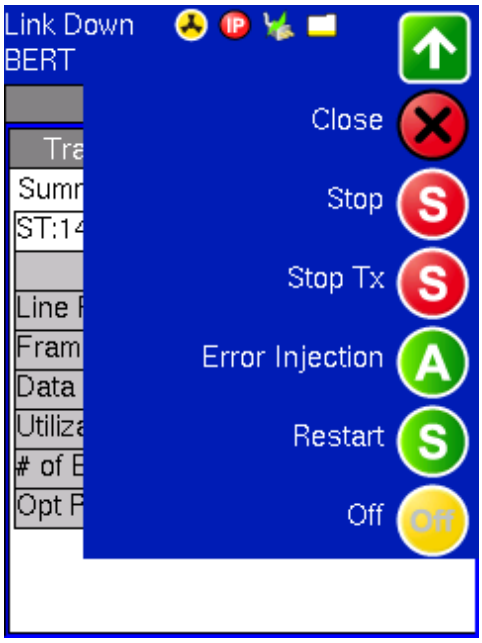
7.1.5 Starting/Stopping a BERT Test

Once all the necessary configurations have been completed, the user can start the test by selecting **Start** from the top right corner action drop-down menu . Once selected, the test will start immediately and the icon will change to a Stop indication. To stop the test, simply tap the **Stop** icon . If testing on any of the fiber ports, ensure the LASER is switched ON before starting the test.

BERT Start



BERT Stop



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7.2 BERT Results

7.2.1 Summary

Summary tab: The following results including the Start (ST) and Elapsed (ET) times are displayed:

- **Line Rate** (Mbps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- **Framed Rate:** (Payload + MAC/IP Header + VLAN Tag + Type/Length + CRC) / (Payload + Total Overhead) * Line Rate % (in Mbps).
- **Data Rate:** Payload / (Payload + Total Overhead) * Line Rate %.
- **Utilization:** % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or

100Mbps) of the total link capacity (or Line Rate).
- **Number of bytes**
- **Optical power:** Optical level measured by the SFP transceiver.

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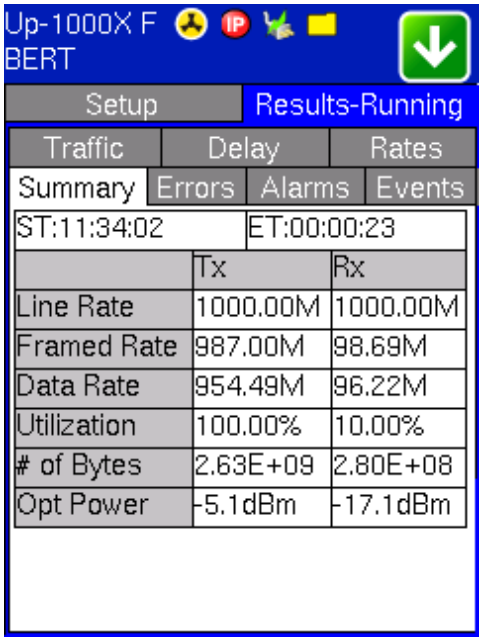
7.2.2 Errors

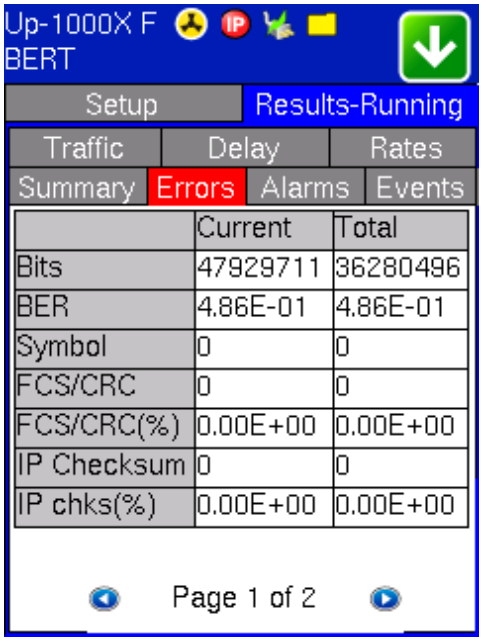
Errors tab: The following Errors (Current and Total) are displayed:

- **Bit:** Indicates errors related to test pattern (Bit Error or LSS [Pattern Loss])
- **BER:** Bit Error Ratio
- **Symbol:** Declared when an invalid code-group in the transmission code is detected
- **FCS/CRC:** Number of received frames with an invalid Frame Check Sequence (FCS)
- **IP Checksum:** (Layer 3 and 4 only) Invalid IP Frame Check sequence
- **IP chks(%)**
- **Jabber frames:** Number of received frames larger than 1518 bytes containing an invalid FCS
- **Runt frames:** Number of received frames smaller than 64 bytes containing an invalid FCS

BERT Results - Summary



BERT Results - Errors



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7.2.3 Events

Events tab: A time stamped record or log of anomalies, alarms, test status (start/stop) and test application are displayed.

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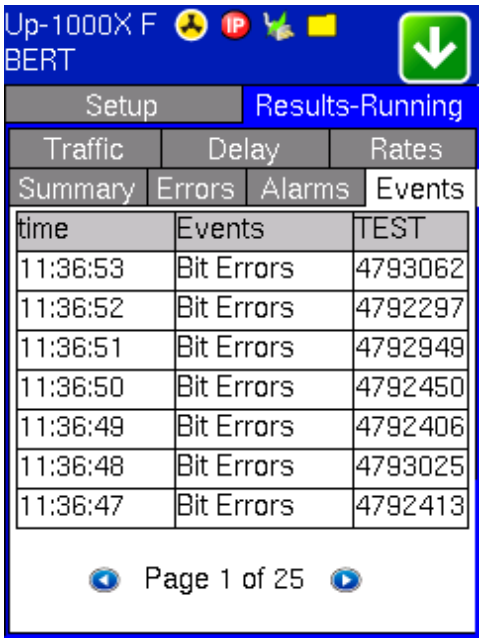
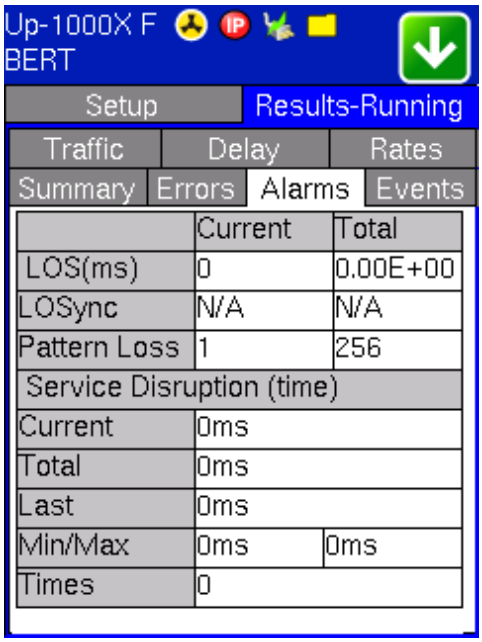
7.2.4 Alarms

Alarms tab: The following Alarms (Current and Total) are displayed:

- **LOS:** Loss of Signal
- **LOS Sync:** Loss synchronization
- **Pattern Loss:** Indicates errors related to test pattern
- Service disruption associated with loss of signal:
  - **Current:** Duration of the current service disruption
  - **Total:** Total accumulated duration of the service disruptions
  - **Min/Max:** Minimum and maximum duration of the service disruption events
  - **Times:** Counter of service disruption events

BERT Results - Events **BERT Results - Alarms**





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7.2.5 Traffic

Traffic tab: Displays the distribution of the received traffic.

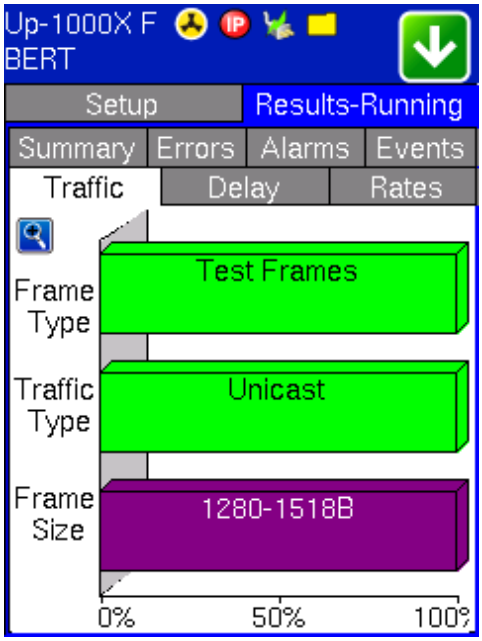
- Frame Type: Test and non-test frames
- Traffic type: Layer 2 and Layer 3 Unicast, Broadcast, and Multicast frame percentage
- Frame size distribution
- Pause frames

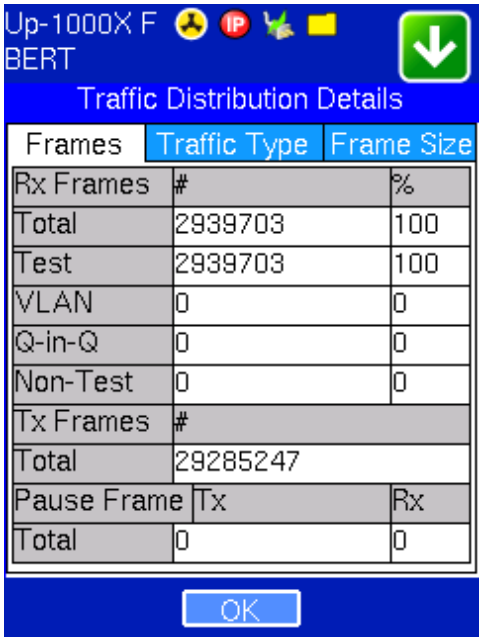
Tap on the graph for detailed screens.

Frames tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- **Received (RX) frames:**
  - Total frames
  - Test frames: Frames containing VeEX proprietary tags
  - VLAN tagged frames
  - Q-in-Q VLAN stacked frames: Multiple VLAN tags
  - Non-test frame
- **Transmitted (TX) frames:**
  - Total frame: Total # frames transmitted
- **Pause frames:** Total number of transmitted and received ethernet pause flow-control frames.

BERT Results - Traffic Graph **BERT Results - Traffic / Frames**





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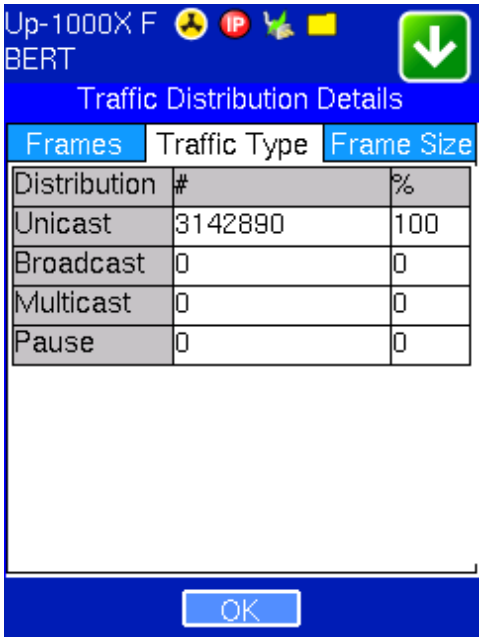
Traffic Type tab: The following Traffic distribution statistics are displayed in Count (#) and Percentage (%):

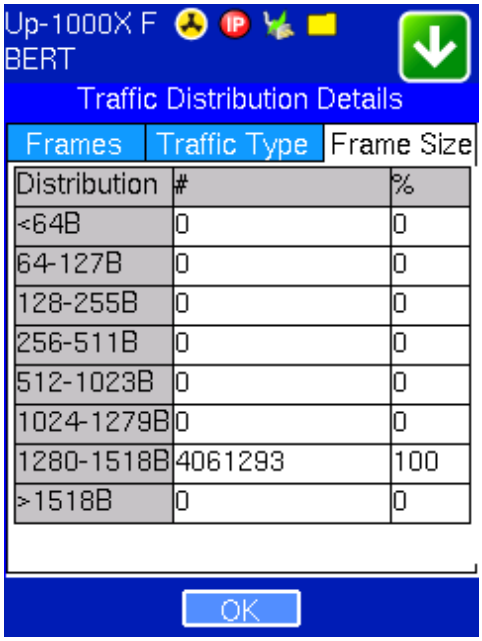
- **Layer 2 Unicast frames:** Number of Unicast frames received without FCS errors.
- **Layer 2 Broadcast frames:** Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF-FF.
- **Layer 2 Multicast frames:** Number of Multicast frames received without FCS errors.
- **Pause frames:** Number of valid flow-control frames received. Frames having a type/length field equal to 8808h are counted as pause frames.
- **Layer 3 Unicast frames:** Number of Unicast frames received without FCS errors.
- **Layer 3 Broadcast frames:** Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF-FF.
- **Layer 3 Multicast frames:** Number of Multicast frames received without FCS errors.

Frame Size tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- < 64 byte frames
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames
- 1280-1518 byte frames
- > 1518 byte frames - Jumbo frames

BERT Results - Traffic Type **BERT Results - Traffic Frame Size**





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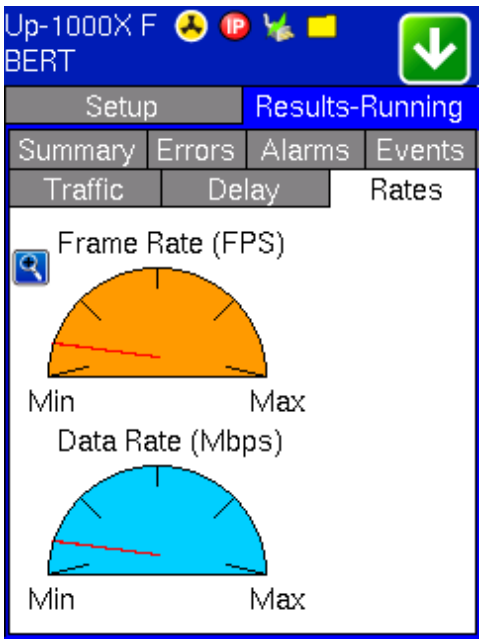
7.2.6 Rates

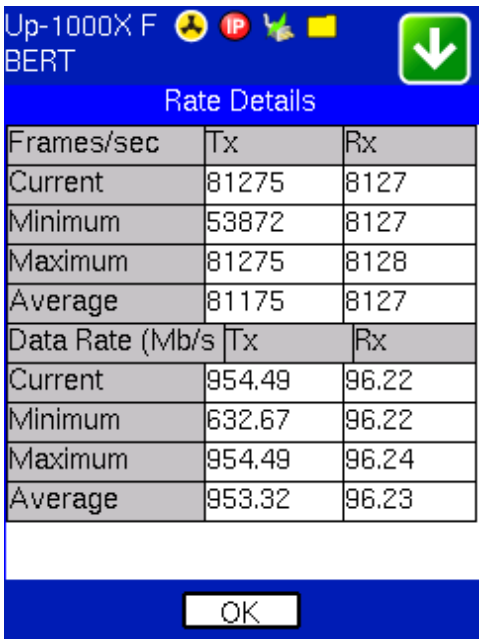
Rates tab: Rate statistics are displayed in a graph format. Tap on the magnifying glass to see rate details in table form. The table shows transmitted **(Tx)** and received **(Rx)** current, minimum, maximum and average frame rates **(FPS)** and Data Rates **(Mbps)**.

Tap on the graph to see detailed screens.

BERT Results - Rates Graph



BERT Results - Rates Details



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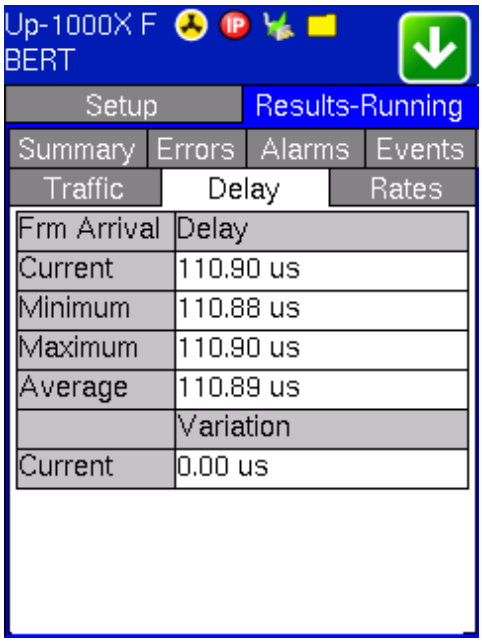
7.2.7 Delay

Delay tab: Delay measures the interpacket gap, start of the frame, and preamble duration. Frame arrival statistics are displayed in tabular format:

- Current
- Minimum
- Maximum

- Variation (Current) - Interframe delay variation

BERT Results - Delay



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7.2.8 Saving BERT Results

Once the test is completed, results can be saved by pressing the save function key on the keypad. The results will be saved and named automatically. Once saved, the user can view or rename the files by going to the results folder of the files menu.

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8.0 RFC 2544 Conformance Testing

Overview:

Service providers often need to test the end-to-end performance of the link when deploying Ethernet services to customers. The Internet Engineering Task Force (IETF) RFC 2544 “Benchmarking Methodology for Network Interconnect Devices” defines tests that describe the performance characteristics of a network interconnecting device.

RFC 2544 recommendations are well accepted in the test and measurement industry for network performance testing. The RFC 2544 test suite consists of and performs a set of four automated tests (throughput, latency, frame loss, and burst or back-to-back) to qualify the performance of a network link under test. The tests are especially popular for the verification of network links with certain service level agreements (SLA).

The following settings must be configured prior to RFC 2544 testing:

- Test layer (Layer 1/2/3/4)
- Frame header (MAC, VLAN, MPLS, IP, UDP, and Data)
- Test frames selection
- Pass/fail thresholds (optional)
- Far-end unit loop control
- Throughput
- Latency
- Frame loss
- Burst (back-to-back)

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8.1 RFC 2544 Setup

Unless otherwise noted, the Header and related setups are identical to the setups described in the BERT Test Application above. A summary of the RFC 2544 setup options are outlined below.

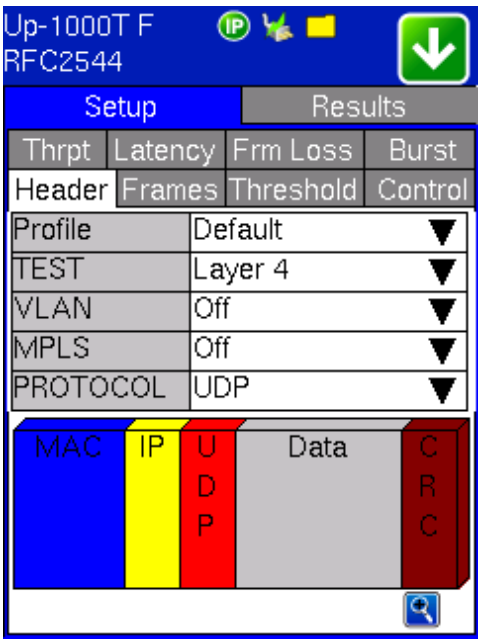
8.1.1 Header Settings

- **RFC 2544 Profile:** Load a previously configured test profile or create a new profile from existing settings. See Profiles for more details on how to create new profiles.
- **Test:** Select the test layer to perform the test.
  - Options are Layer 2, Layer 3, and Layer 4.
- **Frame Type:** Select the Ethernet frame type for Layer 2, Layer 3, or Layer 4.
  - 802.3 Raw (IEEE 802.3 frame without LLC) - not available when Layer 3 is selected
  - 802.3 LLC (IEEE 802.3 frame with LLC header)
  - 802.3 SNAP (IEEE 802.3 frame with SNAP header)
  - Ethernet II (DIX) (named after DEC, Intel, and Xerox, this is the most common frame type today)
- **MAC/IP:** Tap the MAC and IP blocks on the Frame image to access the setup menus.
  - Set the Source and Destination MAC address for Layer 2.
  - Set the Source and Destination MAC and IP addresses for Layer 3.
- **VLAN:** Off, 1 tag, 2 tags, 3 tags.
  - The user is able to configure up to 3 VLAN tags (VLAN stacking, for Q-in-Q applications).
    Note: VLAN stacking is an option.
- **MPLS:** Off, 1 tag, 2 tags, 3 tags.
  - The user is able to configure up to 3 MPLS tags.
    Note: MPLS tag configuration is only available when the MPLS option is purchased.
- **PROTOCOL:** UDP, TCP
- **MAC, VLAN, MPLS, IP, and TCP/UDP Configurations:**

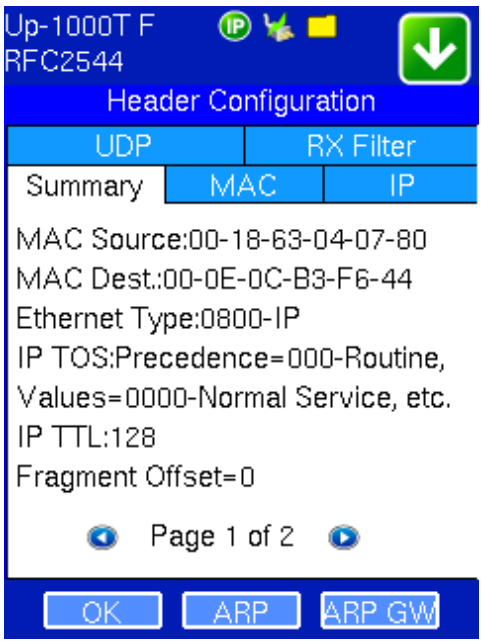
  Tap on the Frame image displayed on the screen to configure the MAC addresses, IP addresses, VLAN tag(s), MPLS tag(s), and test pattern. This brings you to the configuration screens for all the header fields.

  Note: For more information on header configuration please see 7.1.1 Header Settings in the BERT section.

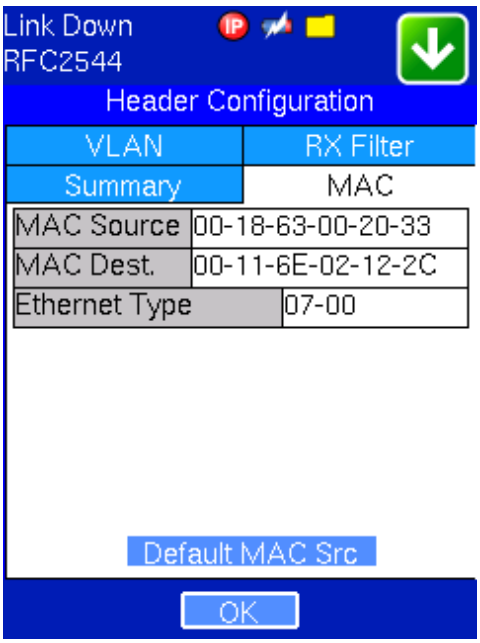
RFC Setup Overview



RFC Setup Summary



RFC MAC Header Tab



RFC 2544 Parameter Summary

Once setup parameters are completed, tapping the zoom function at the bottom right hand side of the screen displays a summary of all settings.

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- **MAC Header Tab:**
  - **MAC Source**: Use the default source address of the test set or configure a new or different address. See MAC address editing screen shot above.
  - **MAC Destination:** Configure the destination MAC address of the far-end partner test set. See MAC address editing screen shot above.
  - **Ethernet Type:** For Layer 3 testing, the user can also configure the Ethertype:
    - 0800-IP (Internet Protocol Version 4, IPv4)
    - 0600-Xerox
    - 0801-X.75 (X.75 Internet)
    - 0805-X.25 (X.25 Level 3)
    - 0806-ARP (Address Resolution Protocol [ARP])
    - 8035-RARP (Reverse Address Resolution Protocol [RARP])
    - 8137-IPX (Novell IPX)
    - 814C-SNMP
    - 8847-MPLS unicast
    - 8848-MPLS multicast
    - 86DD (Internet Protocol, Version 6 [IPv6]) - Future Release
- **Data Tab:** No payload selection is possible.
  The payload area is populated with a VeEX signature field and other proprietary data.
- **RX Filter Tab:** Depending on test layer, allows the user to filter streams by:
  - MAC Destination address
  - MAC Source address
  - VLAN ID
  - IP Destination address
  - IP Source address
- **VLAN Tab:** VLAN ID, priority, and Tag Type (Ethernet Type) can be configured. Please refer to the BERT application for more details.
- **MPLS Tab:** MPLS label, CoS priority settings, TTL, and S-bit fields are configured for available MPLS tags. Please refer to the BERT application for more details.
- **IP Tab:** User configures the source and destination IP addresses.
  The user can also configure the following IP header fields: IP TOS (for quality of service testing), TTL, fragment offset byte, and the protocol field. Please refer to the BERT application for more details.

RFC 2544 Header Setups

The MAC, VLAN, MPLS, and IP configuration procedures are the same as in BERT mode.
Please refer to the BERT Application section for details.

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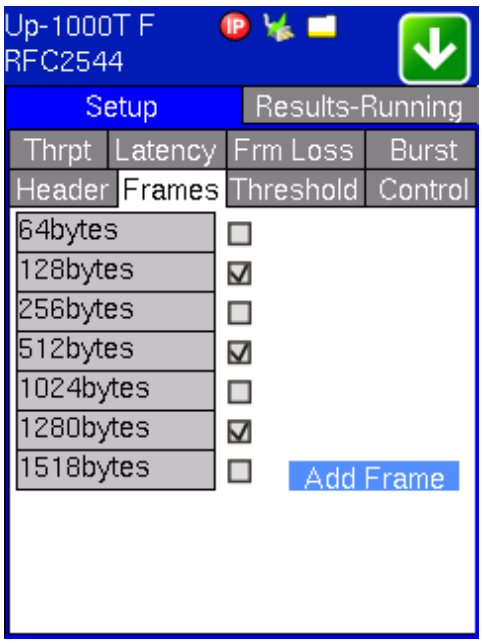
8.1.2 Frame Settings

Frames tab: User Configures:

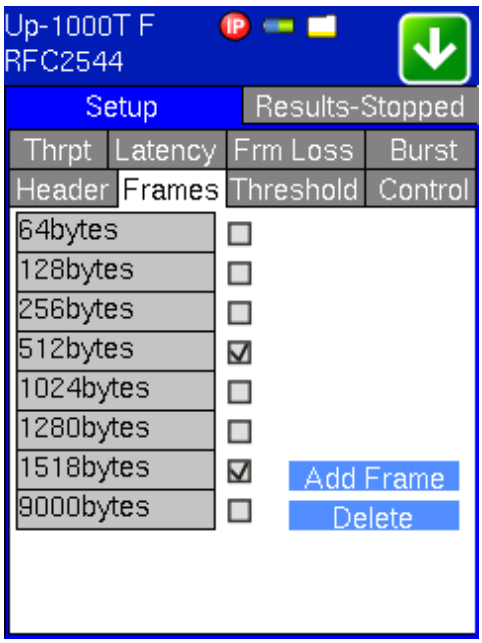
- **Preset Frames:** User selects from a list of recommended test frame sizes defined in RFC 2544:
  - Test frames are 64, 128, 256, 512, 1024, 1280, and 1518 bytes
  - The default selected frames are 64 and 1518 bytes
  - To select/deselect any of the recommended test frames, check the box to the right of the desired frame

- **Add frame:** The user can add two additional user configurable test frames of any size ranging from 64 bytes to 10000 bytes
  - To add additional test frames, tap the **Add Frame** button
  - Enter the frame size using the numeric keypad and click apply
  - Press the back button to return to the frames screen
  - The new custom frame size is displayed; it can be enabled or disabled as needed

RFC 2544 Setup - Frame Settings



RFC 2544 Setup - Jumbo Frame



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8.1.3 Threshold Settings

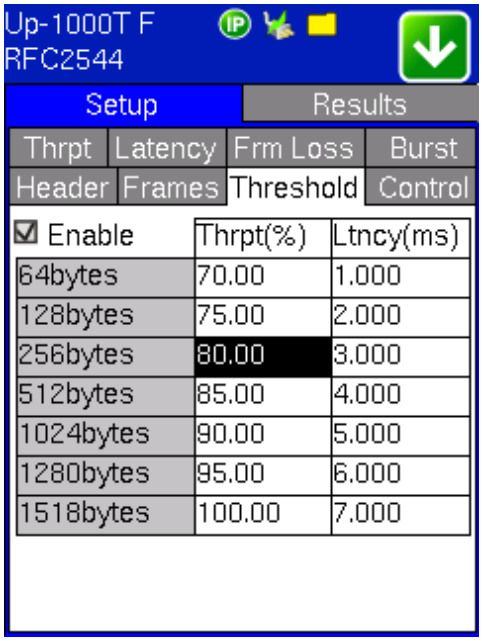
Threshold tab:

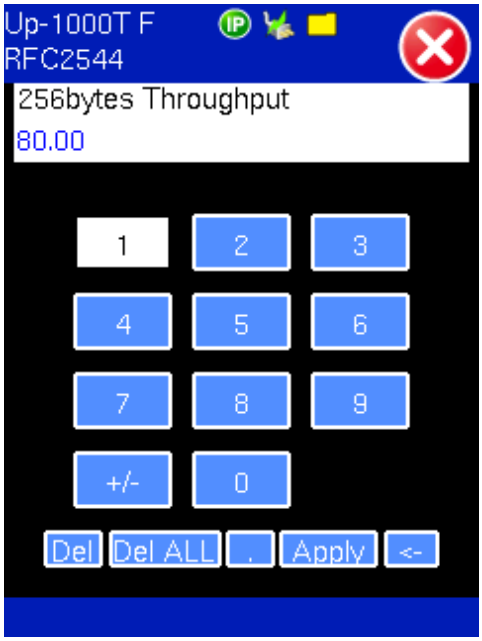
- User enables or disables threshold settings for the throughput and latency tests.
  - When enabled, threshold settings can be configured for all of the test frames selected in the frame settings tab.

- A Pass/Fail criteria will be applied when the threshold settings are enabled.
  - For example, if the throughput threshold value for a 64 byte frame is configured for 80%, then a Pass criteria is assigned if the throughput rate is 80% or better.
  - The threshold values for Throughput and Latency can be customized per user requirements. Tap on the selected value to edit.

RFC 2544 Setup - Thresholds

RFC 2544 Threshold Editing





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8.1.4 Throughput, Latency, Frame Loss, and Burst Settings

The RFC 2544 test suite allows the user to run all four of the tests, one of the four tests, or a combination of any of the four tests. The user simply has to enable/disable which tests to perform by checking/unchecking a selection box in the respective tab for each test. By default all four tests are enabled.

The following parameters must be configured before running the RFC 2544 conformance test suite.

Throughput tab:

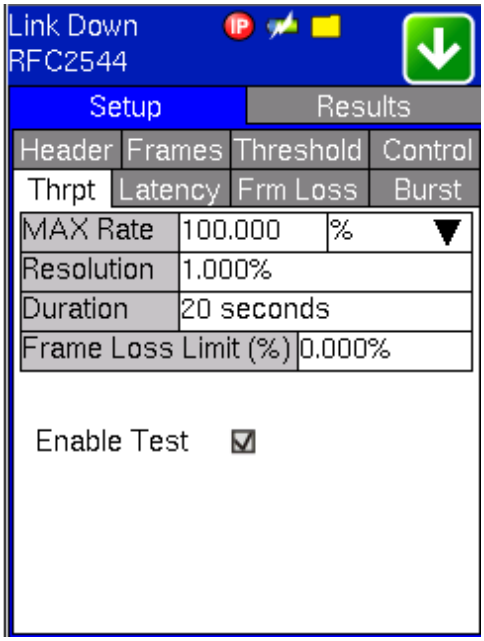
- **Max Rate:** Up to 100% of the negotiated line rate. The default value is 100%.
  - This is the maximum transmit rate to perform the throughput test for each test frame size.
  - The user may configure this rate as a % of the total line rate or in Mbps. For example, if the user configures the max rate to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.

- **Resolution:** Input any value between 0.001% and 1%. The default value is 1%. Resolution refers to the resolution in searching for the throughput rate. If 1% is selected, the throughput rate will be searched with ±1% accuracy.

- **Duration:** 5 to 999 seconds. The default value is 20 seconds.
  - The duration is the amount of time the throughput test is run for, for each frame size at a given rate.

- **Frame Loss Limit (%):** Configures the frame loss tolerance used in the throughput rate search algorithm. If the frame loss count stays below the configured Frame Loss limit, the throughput rate search will stop, otherwise the throughput rate search will continue to the next step.

RFC 2544 Setup - Throughput



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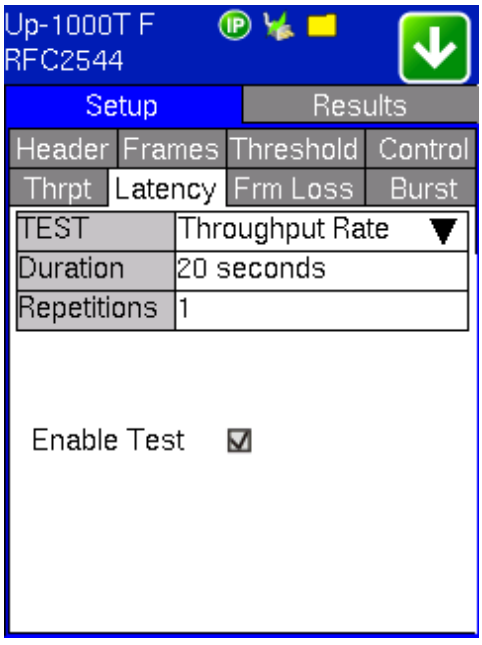
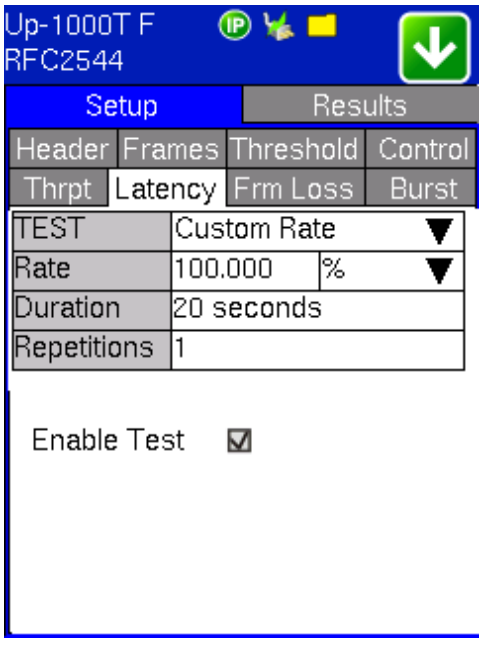
Latency tab: User configures:

- **Test:** Throughput Rate or Custom Rate. The default value is throughput.
  - **Throughput rate:** Latency test will be performed at the throughput rate found for each of the tested frame sizes.
  - **Custom rate:** User configures a custom rate in % or Mbps.
- **Rate:** Only available if Custom Rate is selected. Enter up to 100% of the negotiated line rate or enter the rate in Mbps.
- **Duration:** 5 to 999 seconds. The default value is 20 seconds.
  This is the amount of time that the latency test will be performed for each test frame size.
- **Repetitions:** 1 to 100. The default value is 1.
  This is the amount of times that the latency test will be repeated for each test frame size.

RFC 2544 Setup - Latency Throughput Rate



RFC 2544 Setup - Latency Custom Rate



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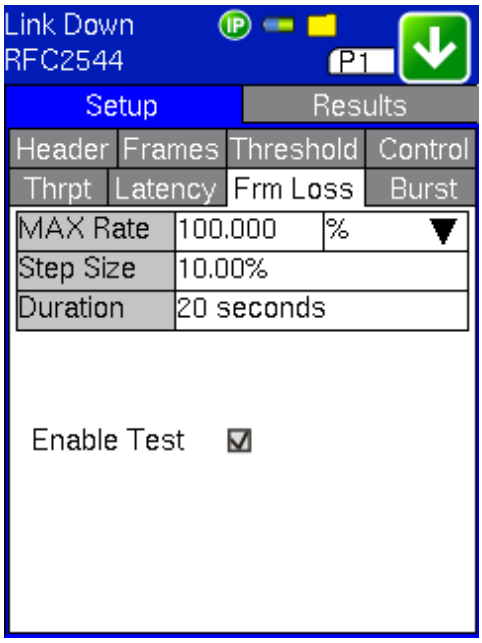
Frame Loss tab:

- **Max Rate:** Up to 100% of the negotiated line rate. The default value is 100%.
  - This is the maximum transmit rate to perform the frame loss test for each test frame size.
  - The user may configure this rate as a % of the total line rate or in Mbps. For example if the user configures the Max Rate to be 90% and the negotiated line rate of the link is 100Mbps, then the maximum transmit rate will be 90Mbps or 90% of the line rate.
- **Step Size:** 1 to 10%. The default value is 10%.
  - The step size is the rate % that the frame loss test will be reduced by in the event of any frame loss. For example if the Max Rate is 100Mbps (or 100%) and frames are lost at this rate, then the transmit rate will be reduced to 90Mbps (or 90%).
  - The frame loss test will now be performed at the new rate until there is zero frame loss at two consecutive rate settings. This means that the test will have to be performed at 80% (assuming that there was zero frame loss at 90%).
- **Duration:** Selectable in the range of 5 to 999 seconds. The default value is 20 seconds.
  - The duration is the amount of time the throughput test is run for, for each frame size at a given rate.

RFC 2544 Setup - Frame Loss



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Burst (Back-to-Back) tab:

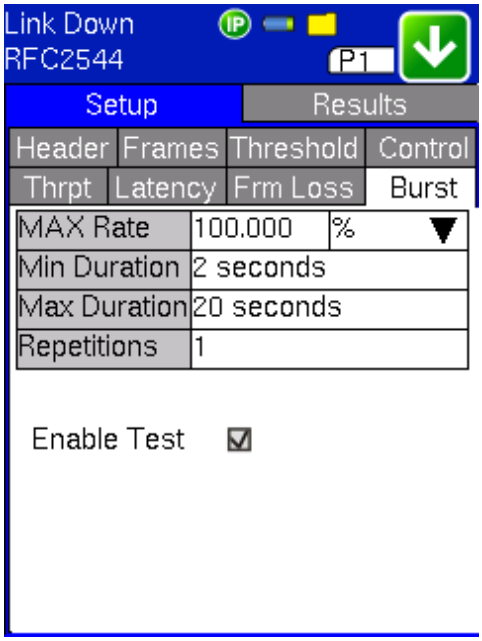
- **Max Rate:** The default value is 100%.
  In the burst test, frames are always transmitted at the maximum rate for a given minimum and maximum burst duration.

- **Minimum Duration:** Selectable in the range 2 to 999 seconds. Default value is 2 seconds.
  This is the duration of the first burst.

- **Maximum Duration:** Selectable up to 999 seconds. The default value is 20 seconds.
  This is the duration of the second burst, which must be greater than the minimum burst.

- **Repetitions:** Selectable in the range 1 to 100. The default value is 1.
  This is the amount of times that the burst test will be repeated for each test frame size.

RFC 2544 Setup - Burst



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8.1.5 Control Settings

Overview:

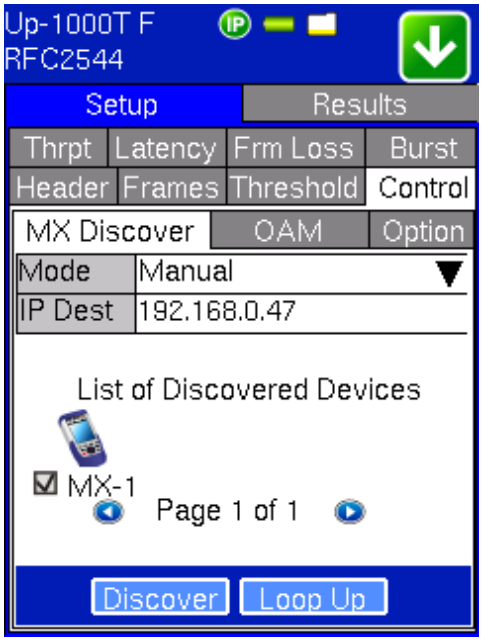
Asymmetrical links provide different line rates in the two directions. To verify the information for both the low and the high rates of the link, the user needs to send a test signal from one instrument located at one end of the link to an instrument at the other end of the link and vice versa to test traffic capacity. The two test instruments have to be synchronized because the tests defined in RFC 2544 require the receiver to know the contents of the test signal to be transmitted in detail.

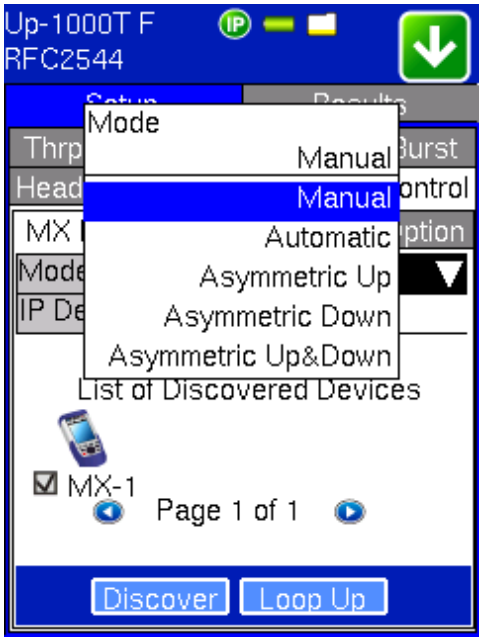
The MX100e+/MX120e+ offers an automated RFC 2544 test application to perform throughput, frame loss, and burstability tests in a local-remote unit setup. The user first configures the test setup in the local unit. Once initiated, the local unit transfers the setup information to the remote unit via the line under test. Upon completion, the remote unit transfers the test results back to the local unit, enabling the user to read the results for both directions of the link on the local unit.

RFC 2544 End-to-End Testing

Control button:

RFC 2544 Setup - Control Manual **RFC 2544 Setup - Control Modes**





MX Discover

Configures the loop up and loop down commands necessary to control the remote unit or the test profile in the case of Asymmetric testing. Use the local unit to configure local and remote unit settings.

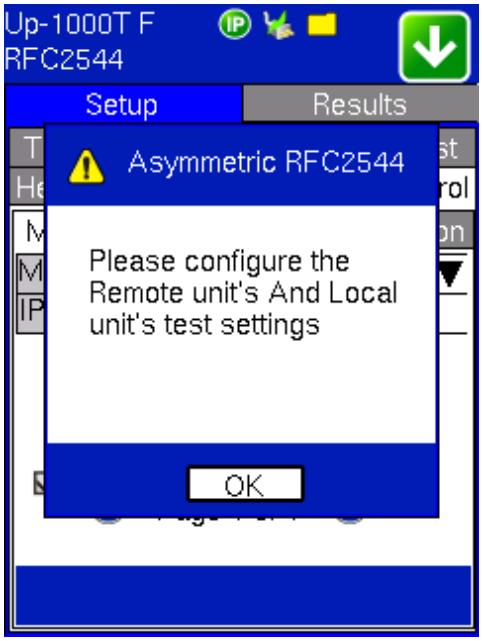
- **Manual:** User must input the destination IP address of the far-end device
- **Automatic:**
  - No configuration is necessary - user only has to select the "discovered" far-end device to control
  - Select from a list of discovered devices to loop up/down

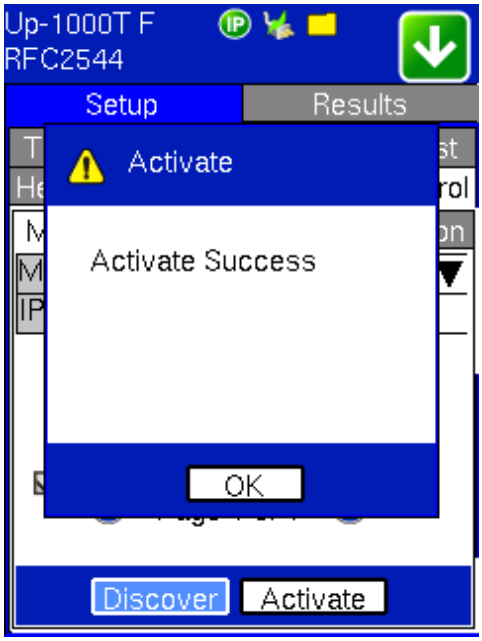
Asymmetric Mode

- **Asymmetric Up:** Tests traffic in the upstream direction (local to remote direction)
- **Asymmetric Down:** Tests traffic the downstream direction (remote to local direction)
- **Asymmetric Up & Down:** Test traffic in both upstream and downstream directions

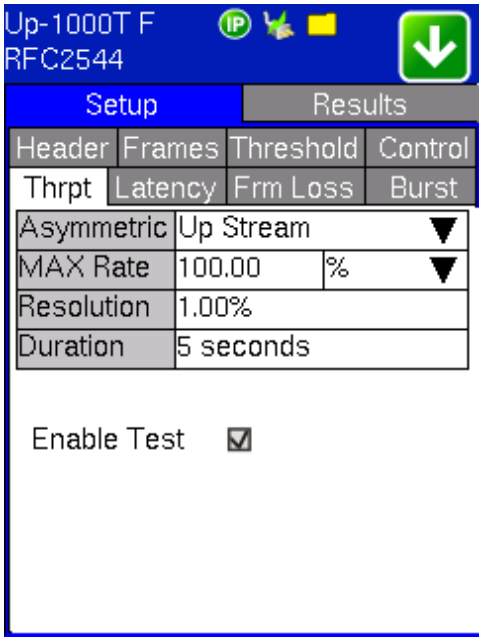
When selecting any of the asymmetric modes, an **Activate** button will appear on the MX Discover screen. Press **Activate** to enable the asymmetric settings. After selecting an asymmetric mode, select Up Stream or Down Stream configuration from the **Asymmetric** box in the **Throughput**, **Frame Loss**, and **Burst** tabs.

Asymmetric Message **Activate Success**

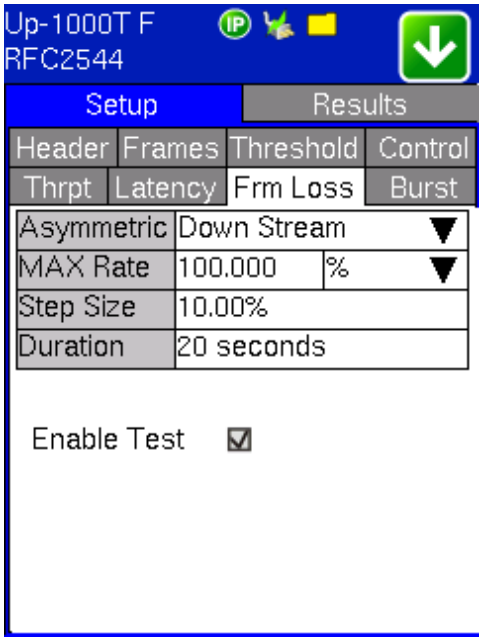




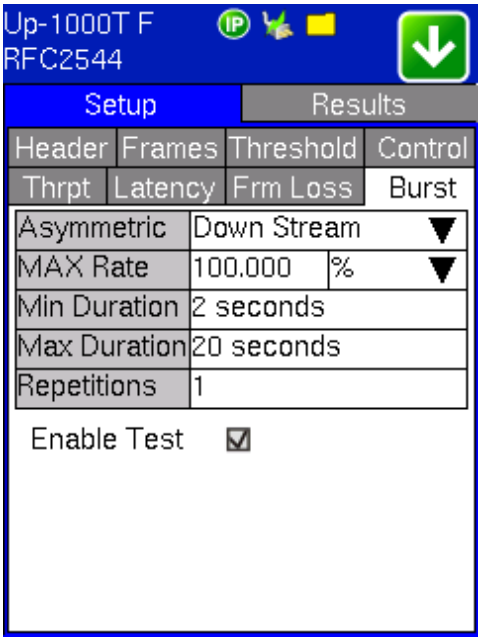
Asymmetric Throughput



Asymmetric Frame Loss



Asymmetric Burst



Accessing Upstream and Downstream Settings

Depending on the Control Mode selected (e.g. Asymmetric mode), test settings for upstream and downstream are also displayed.

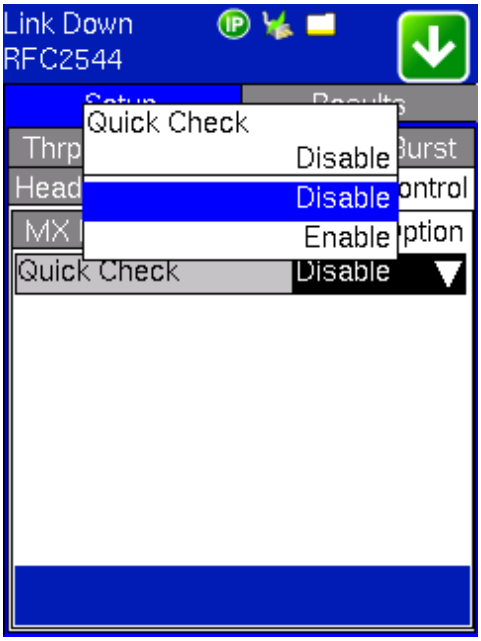
OAM Discover

For more information on OAM Discover, please see the BERT OAM Discover section under 7.1.4 Control Settings.

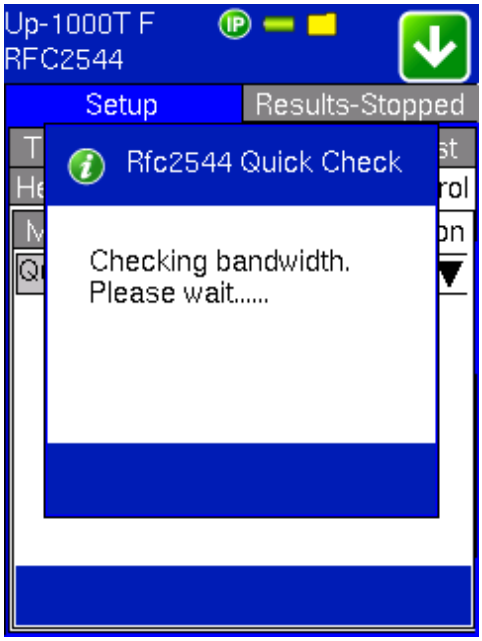
Option > Quick Check:

Prior to conducting any tests, Quick Check transmits and receives traffic to verify that remote and local units are configured correctly. Select **Enable** in the drop-down menu and press **Start** from the action menu to start Quick Check. If Quick Check is able to successfully transmit and receive frames, a dialogue box will appear, giving the user the option of continuing the current test.

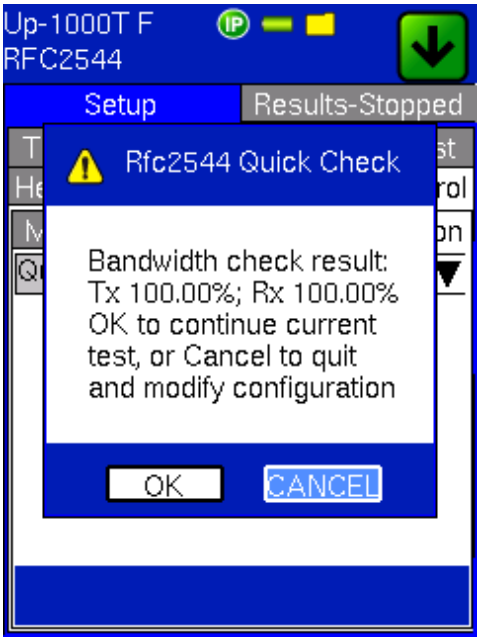
RFC 2544 Control Setup - Quick Check



RFC 2544 Control Setup - Quick Check Message



RFC 2544 Control Setup - Quick Check Message



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8.1.6 Starting/Stopping an RFC 2544 Test

Once all configurations have been made, the user can start the RFC 2544 test. The following are two scenarios of how to prepare and start the unit for RFC 2544 testing.

Note: If testing on fiber ports, make sure the LASER is turned on before starting the test.

Far-End Unit in Manual Loopback Mode

- If the far-end unit (another MX) is already in a manual loopback mode, do not send a loop up command since it is not necessary
- Once the correct control settings are configured, the user can start the test

The selected tests will run automatically. When all the tests are complete the test will stop automatically. If the RFC 2544 test suite needs to be stopped before they are done, then simply press the **Stop** button, located in the Action drop-down menu. The status of each selected test can be seen in the Results tab.

Far-End Unit Controlled with Loop Up/Down Commands

- If the far-end unit is not manually looped back, then it must first receive a loop up command from the control unit before the RFC 2544 test suite can be started
- To loop up the far-end unit with the manual mode loop up/down commands, configure the control settings mode to manual
- Enter the MAC and/or IP address of the far-end unit
- Send the loop up command by pressing **Loop Up**

Once the far-end unit has been looped back, start the test by pressing the Start button. When all of the selected tests are completed, the RFC 2544 test suite will stop automatically. Once all tests have been completed and there is no need to test again, go back to the Control tab, and press the **Loop Down** button. This will send a loop down command to the far-end unit to remove the loopback that is in place.

Start the RFC 2544 test, and loop down the far-end unit when all tests have been completed.

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8.2 RFC 2544 Results

The progress and current result of the RFC 2544 can be viewed as the test is in progress.

Results tab

Navigate the respective sub-tabs (throughput, latency, frame loss, or burst) to view the results for each test. For the burst test the results can be viewed in summary table format or test log format.

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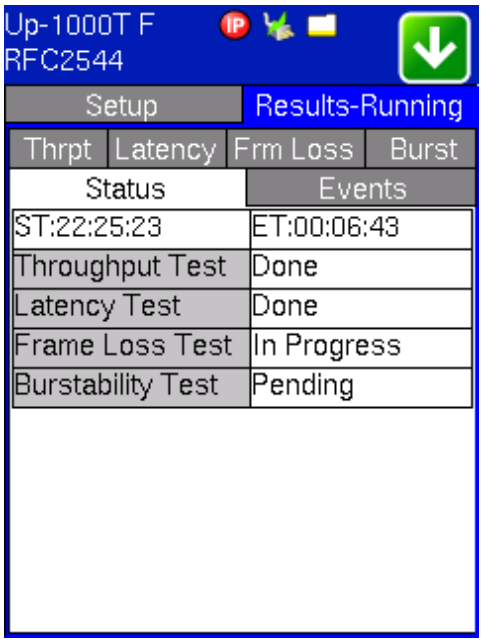
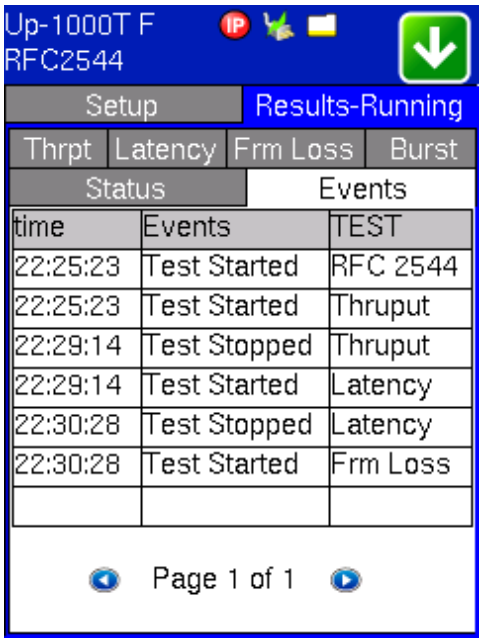
8.2.1 Status and Events

The status of each test is displayed including a time stamped log of each test.

RFC 2544 Results - Status



RFC 2544 Results - Events



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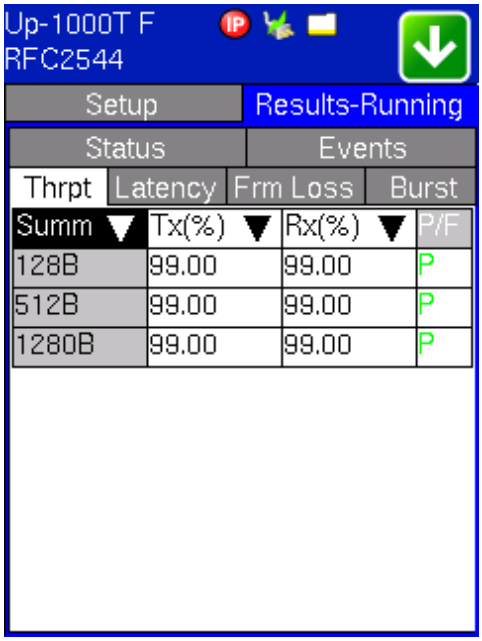
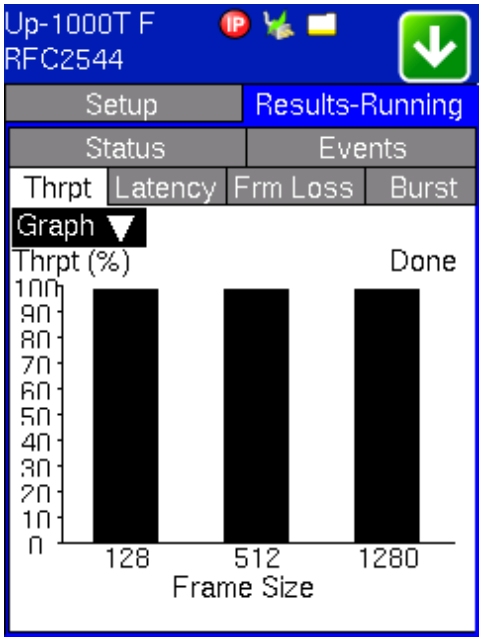
8.2.2 Throughput

The Throughput tab displays the maximum throughput rate of the link under test. Results are displayed in graphical and table formats. Use the drop-down menu to change the display format.

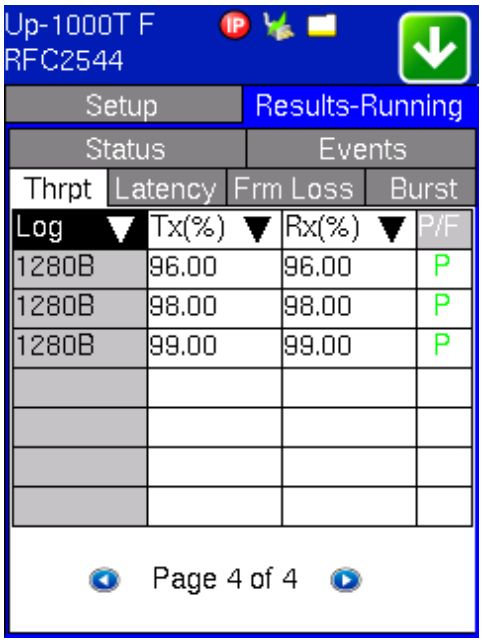
- Graphical: Throughput results are displayed in a bar graph form
- Summary table and test log table display:
  - Byte size
  - **Tx(%):** Percentage of test frames transmitted by the unit
  - **Rx(%):** Percentage of test frames received by the unit
  - **P/F:** Pass/Fail test status determined by test criteria set in the Threshold tab

RFC Results - Throughput Summary **RFC Results - Throughput Graph**





RFC Results - Throughput Test Log



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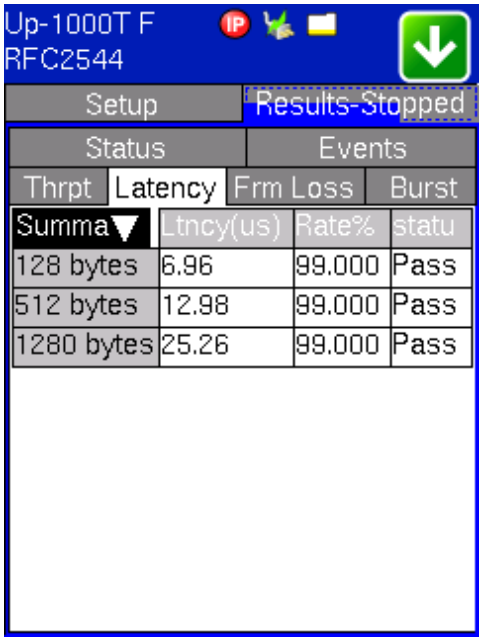
8.2.3 Latency

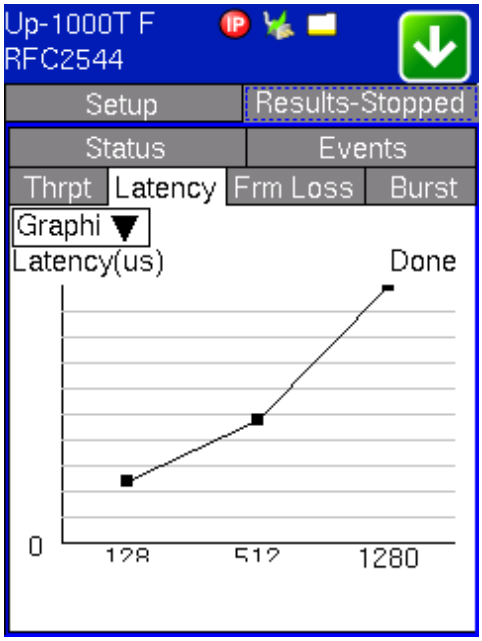
Latency and frame jitter measurements results are displayed in the following formats. Use the drop-down menu to select the Latency format:

- Graphical: Latency results displayed in line graph form (Latency [us] vs Frame size [bytes]).
- Summary and Test log tables display:
  - Byte size
  - **Latency (us):** Round trip delay latency.
  - **Rate (%):** Percentage of frames transmitted. Data rate used for latency test.
  - **Pass/Fail** test status.

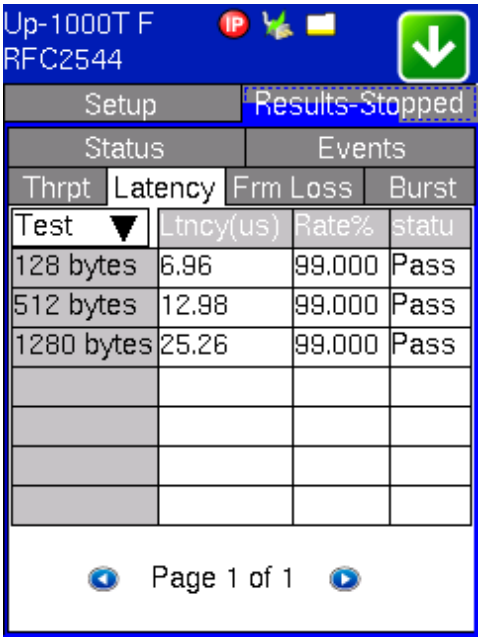
RFC Results - Latency Summary **RFC Results - Latency Graph** **RFC Results - Latency Test Log**



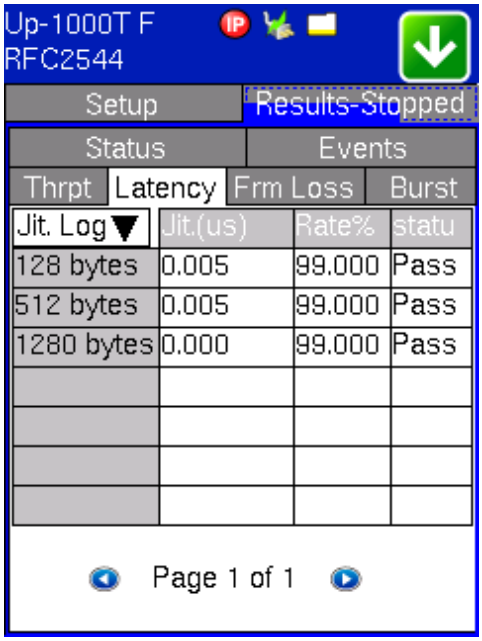
RFC Results - Latency Jitter Graph

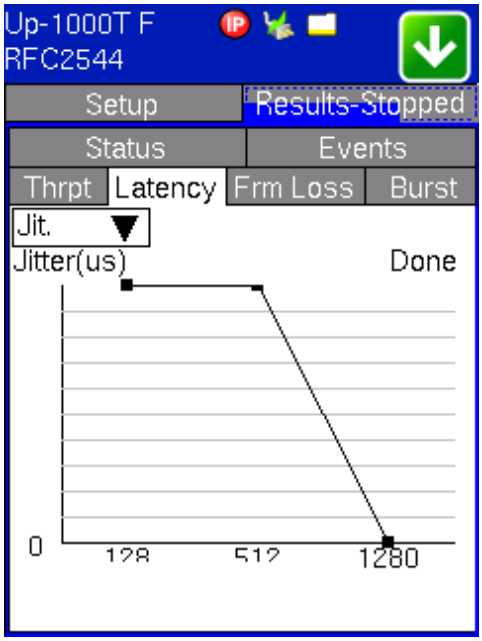


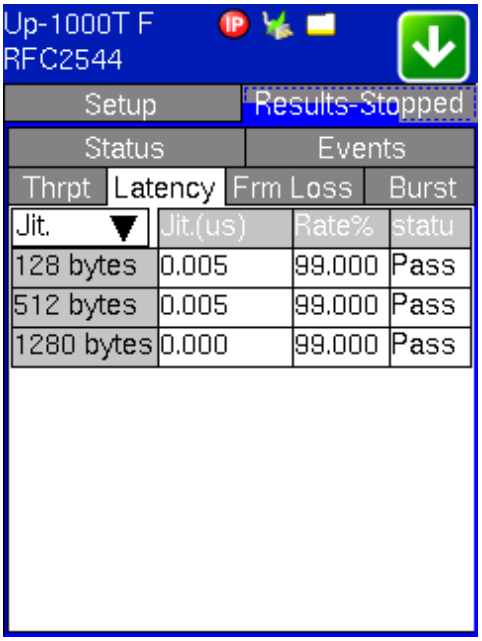
RFC Results - Latency Jitter Summary



RFC Results - Latency Jitter Log







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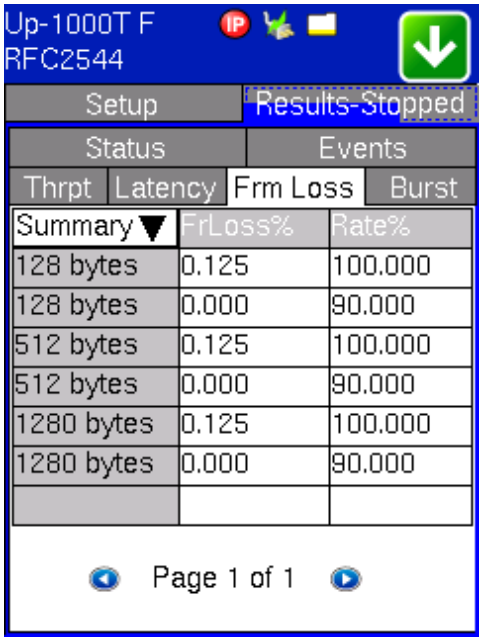
8.2.4 Frame Loss

Frame loss displays the percentage of frames not received. Use the drop-down menu to select the Frame Loss format:

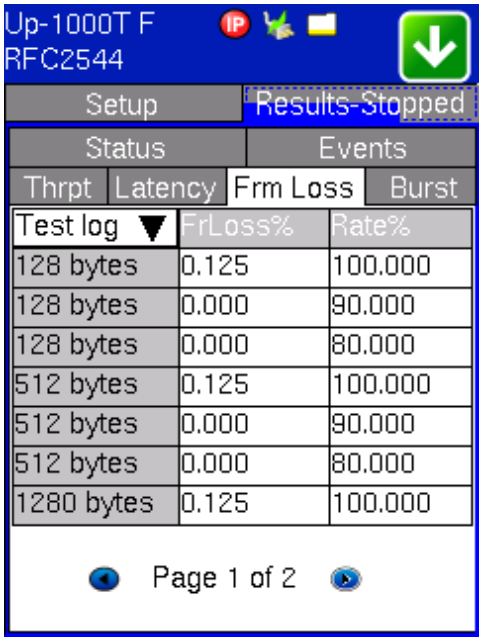
- Summary and Test log tables display test frame length, byte size, **frame loss (%)** from received traffic, and **rate (%)** transmitted.
- Graphical: Frame Loss displayed in line graph form (Frame size [bytes] vs Rate [%]). Tap on the magnifying glass to see the legend.

RFC Results - Frame Loss Summary

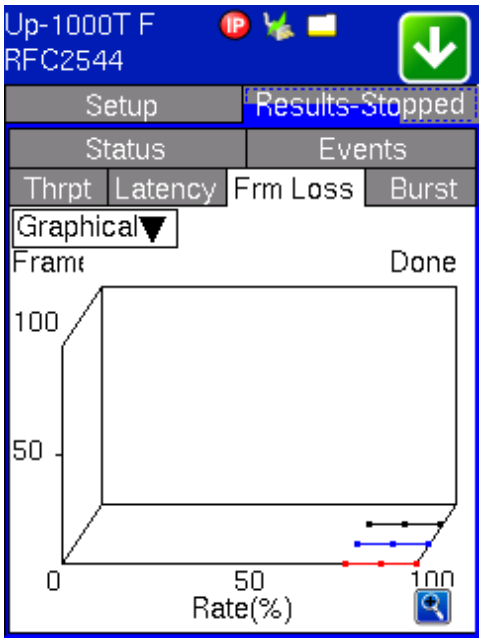
RFC Results - Frame Loss Test Log

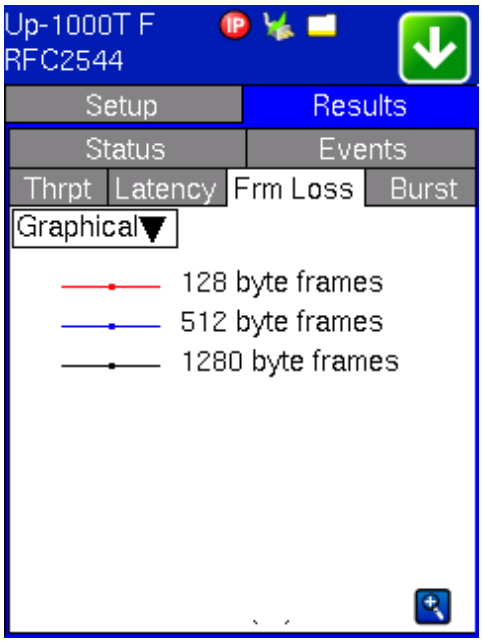


RFC Results - Frame Loss Test Graph



RFC Results - Frame Loss Graph (Zoomed)





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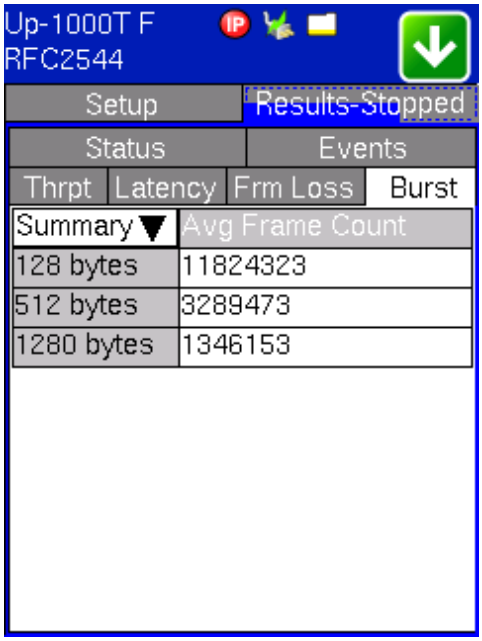
8.2.5 Burst

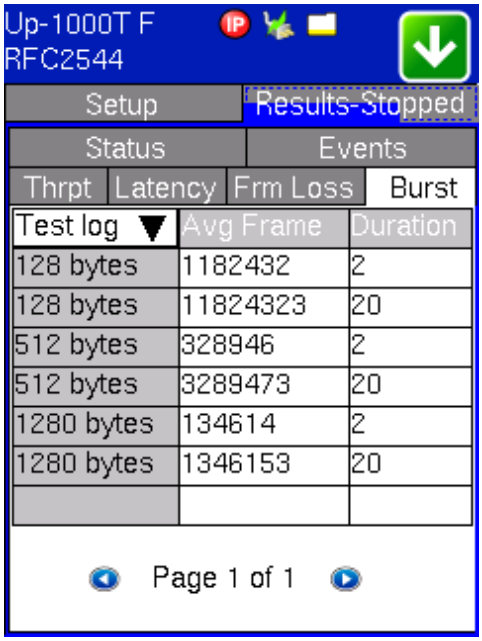
Burstability (back-back) results are the number of frames successfully transmitted/received at the line rate. It is displayed in the following formats:

- Summary table: Displays **Average Frame Count** received for each test frame length
- Test log table: Displays **Average Frame Count** and **Duration** (seconds) for each test frame length

RFC Results - Burstability Summary

RFC Results - Burstability Test Log





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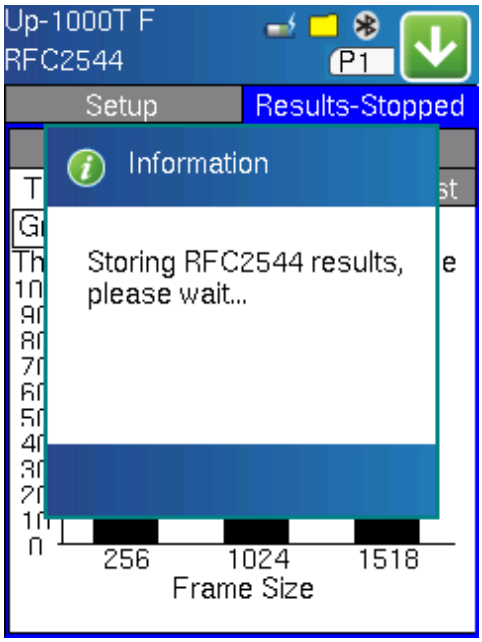
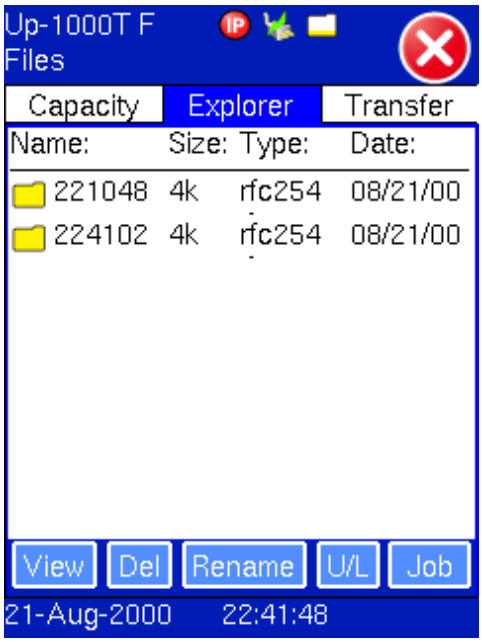
8.2.6 Saving RFC 2544 Results

Once the test has been stopped the results can be saved by pressing the save key on the keypad. The results will be saved and named automatically. Once the results are saved, the user may view or rename the results file by going to the Explorer folder located in the Files menu.

RFC Results - Storage



RFC Results - File Explorer



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9.0 Throughput Testing (Multiple Streams)

Overview:

The throughput application (or the multiple streams application) performs the following measurements:

- Throughput performance
- Frame loss analysis
- Delay analysis

- Frame/packet arrival analysis
- Received traffic type analysis
- Received traffic frame size analysis

On the transmit side, the throughput application allows for the configuration of up to 8 traffic streams with their own MAC and IP addresses, VLAN tags (up to 3 per stream), bandwidth/rate, frame size, and L2 and/or L3 quality of service (QoS) parameters. On the receiver end, the traffic is analyzed on a per stream (up to 8 streams) basis as well as a global or aggregate measurement.

This application is very useful in verifying the transport of traffic with different prioritization settings across a network link. The test helps verify that the network can handle high priority traffic and low priority traffic accordingly.

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9.1 Setup

Unless otherwise noted, the Frame Header and related setups are identical to the BERT and RFC 2544 Applications described above. The following parameters must be configured prior to performing a Throughput test:

- Number of streams (see **General Settings** below)
- Bandwidth per stream (see **General Settings** below)
- Test layer
- Frame Type
- VLAN tag(s)
- MPLS tag(s)
- Frame header per stream (if applicable)
- Traffic profile per stream (if applicable)
- Error injection per stream (if applicable)
- Control settings of the far-end device(s) (if applicable)

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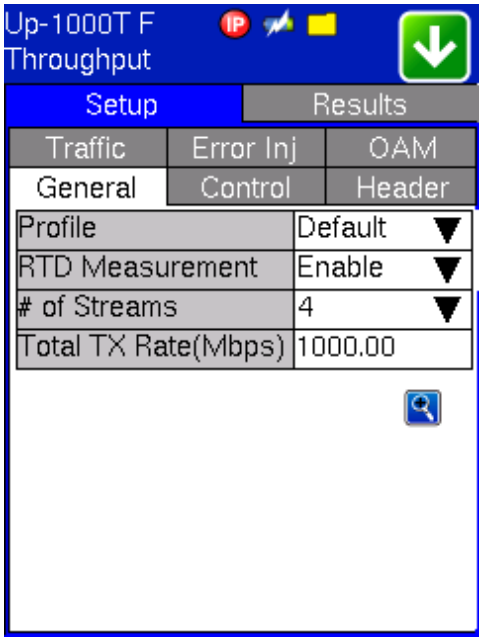
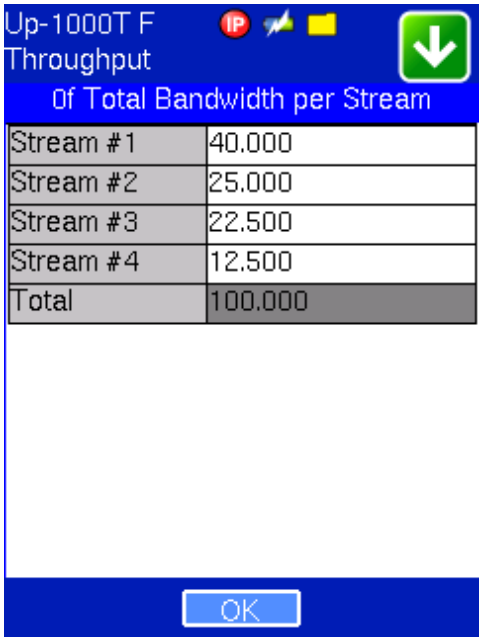
9.1.1 General Settings

- **Profile:** Load a previously configured test profile or create a new profile from the existing settings.
- **RTD Measurement:** Enable/disable the round trip delay measurement. It should only be enabled when running the test to a remote loopback.
- **Total TX Rate (Mbps):** Sum of all stream rates.
- **# of Streams:** From 1 to 8 streams. Pressing the zoom function (magnifying glass) displays the Bandwidth allocated per stream.
  Note: The total bandwidth for all streams cannot exceed 100%.

Throughput Setup - General **Throughput Setup - Stream BW Overview**





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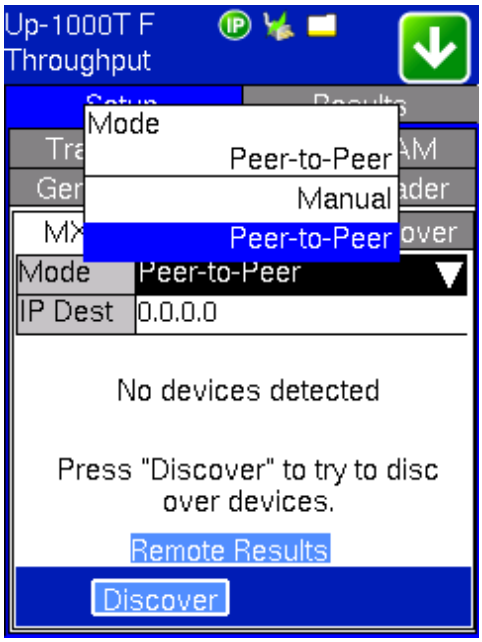
9.1.2 Control Settings

MX Discover:

- Configures the loop up and loop down commands necessary to control the far-end unit. The user is allowed to configure the commands manually or automatically.
  - **Manual selection:** User must input the destination MAC/IP address of the far-end device including the command type
  - **Peer-to-Peer:** When the local unit connects to the remote (peer) partner, it loads the same configuration profile (header, traffic, and frame size) to the remote partner, with the MAC and IP addresses inverted

Throughput - Control Setup (Peer-to-Peer)



Throughput - Control Setup - OAM Discover

OAM Discover: OAM discovered devices will be listed. Select an OAM link partner and press the **Loop Up** button to set the far-end device into loopback mode. This will send a loop down command at the end of the test.

For further instructions on connecting to an OAM device, please refer to OAM Discover under 7.1.4 Control Settings in the BERT section.

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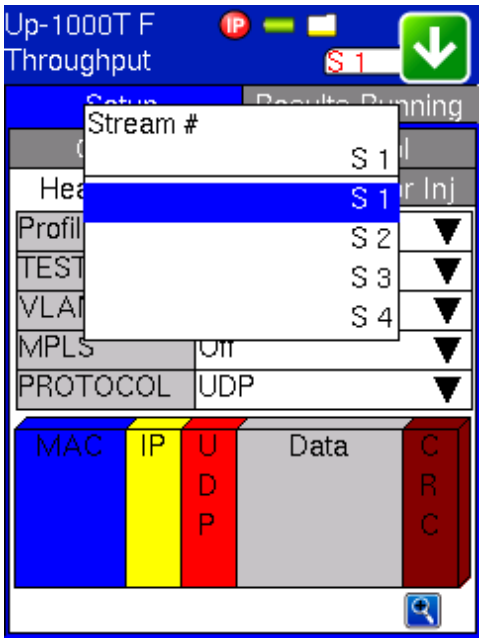
9.1.3 Header Configurations (Individual Streams)

Selecting a Stream to Configure

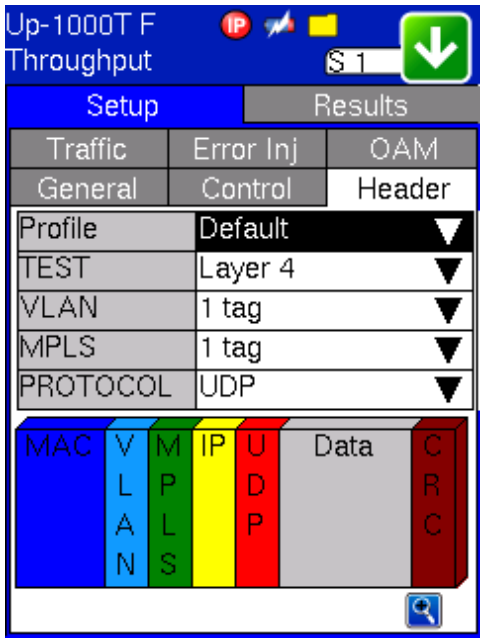
Please note that for any of the per stream configurations (Header, Traffic, and Error Injection), a stream number will be displayed. The user must select each stream number separately to configure the respective parameters. Select the stream # by tapping the stream number box at the top right hand side of the screen.

Note: For information on header configuration please see 7.1.1 Header Settings in the BERT section.

Throughput Setup - Selecting a Stream



Throughput Setup - Header / Stream 1



Multiple Streams

All streams are configured for the same test layer; if Layer 2 is selected, then all streams will be Layer 2 traffic.

MAC Setup

MAC configuration in the Throughput section features MAC flooding for buffering verification and performance testing of Ethernet switches.

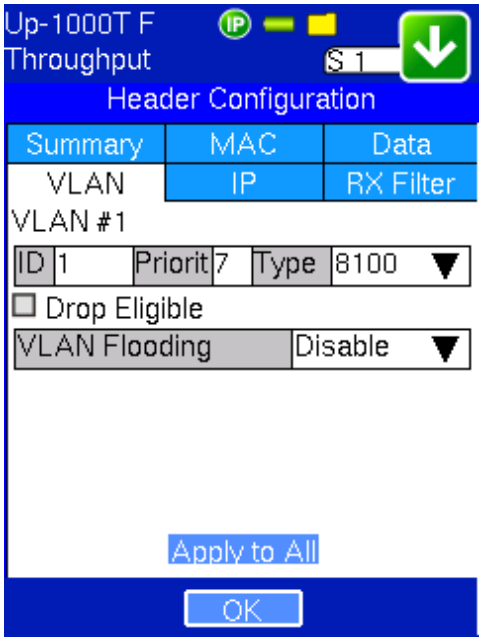
- **Source (SRC) and Destination (Dest) flooding:** Enable or Disable.
- **Flood Range:** Specifies the number of MAC source and/or destination addresses. Enter a number from 0-4095. The source and/or destination MAC addresses will be incremented by 1 until it reaches the number of times entered in the flood range.

VLAN Setup

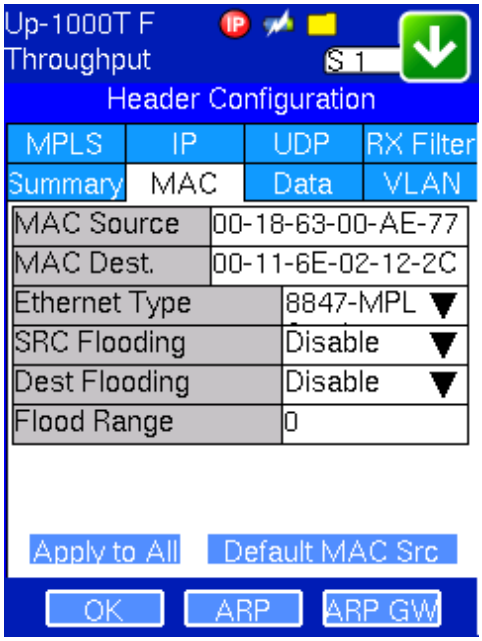
Note: Please see 7.1.1 Header Settings in the BERT section for further details on MAC and VLAN configuration options.

Note*: VLAN and MAC Flooding are only available for single stream testing.

Throughput - VLAN Setup



Throughput - MAC Setup



Multiple Streams - MAC/IP address setups

If all streams are going to the same far-end unit, the MAC/IP destination addresses must be the same on all of the streams.

If any of the traffic streams are going to more than one far-end unit, please ensure that the correct MAC/IP destination addresses are configured for the respective streams.

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9.1.4 Traffic Settings (Individual Streams)

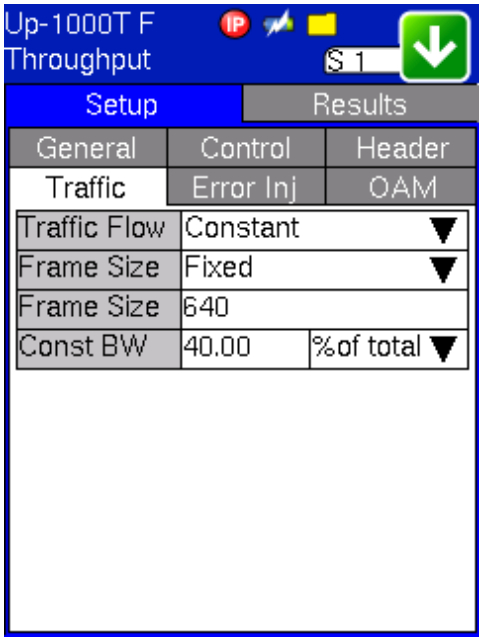
In the Traffic tab the user is able to configure the traffic profile per stream, including frame size selection, traffic type, and transmit rate. If the same traffic type applies to all streams, apply this profile to all streams using the **Apply to All** button.

- **Frame Size:** Enter the frame size when a Layer 2 or Layer 3 is selected. Frame size configuration is not available for Layer 1. Frame sizes can be from 64 bytes to 1518 bytes, in addition to jumbo frames up to 9k bytes.
- **Traffic Flow:** Select from Constant, Ramp, Burst, or Single Burst traffic flow.
- **BW (Transmit Bandwidth):** Configure the transmit rate for the stream.
  Note: The bandwidth allocation per stream is already configured in the General Settings tab, but can be modified in this screen as well.

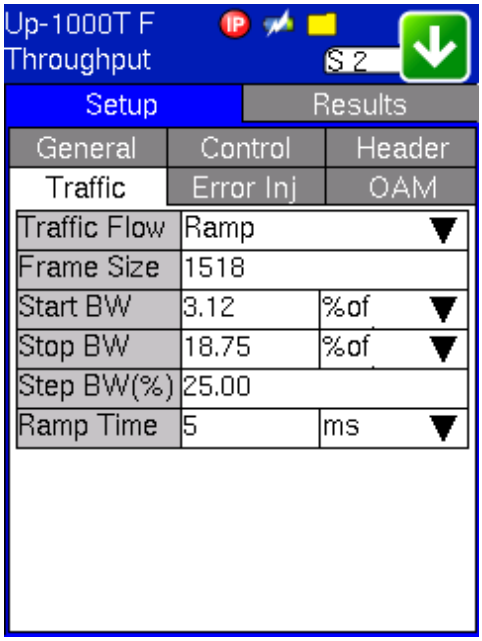
For more information on Traffic Settings, please see 7.1.2 BERT Traffic Settings.

Throughput - Traffic Setup - Constant

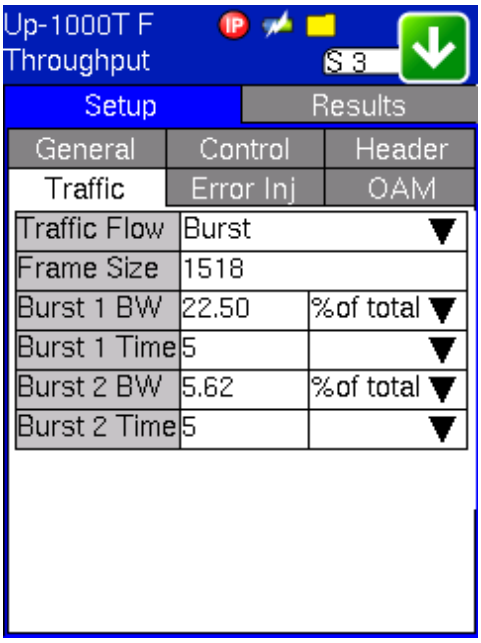
Throughput - Traffic Setup - Ramp

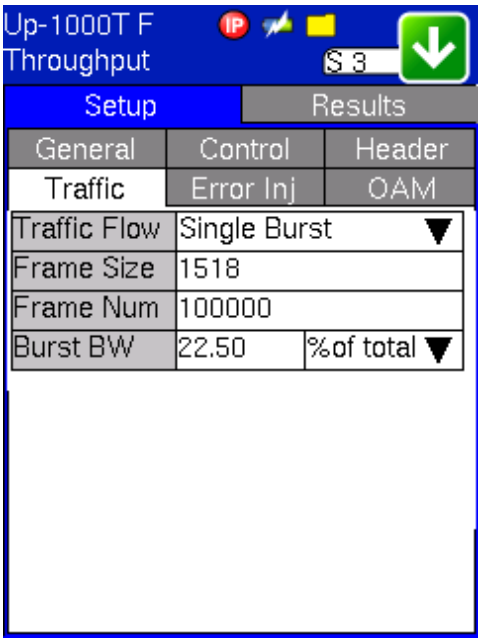


Throughput - Traffic Setup - Burst



Throughput - Traffic Setup - Single Burst





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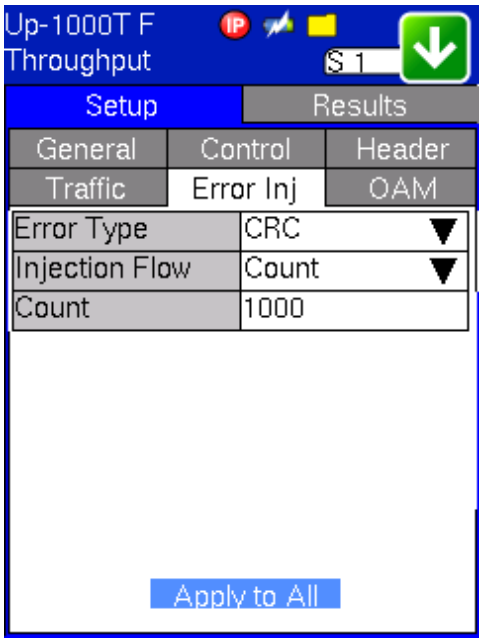
9.1.5 Error Injection Settings (Individual Streams)

Error injection can be performed during the test. The type of errors and error injection are configured in the Error Injection tab. Once the test is running, error injection can be performed by pressing the **Error Injection** button on the right side of the screen.

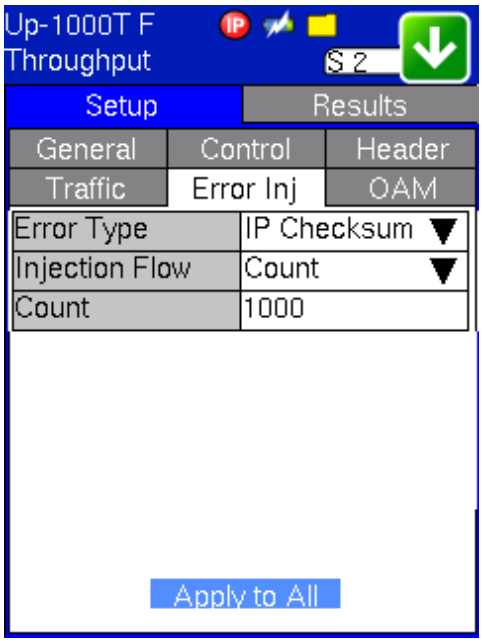
- **Error type:** Select from Bit, CRC, IP Checksum (Layer 3, 4 only), Pause, TCP/UDP Checksum (Layer 4 only). With Pause selected, the unit will transmit a pause frame when error injection icon is pressed. The Pause time duration is configurable in units of 512 bit time. At Gigabit Ethernet speed, this is equivalent to 512 ns. For example, if pause time is set to 1000, the pause duration will be set to 1000x512 ns.
- **Injection Flow:** The error injection flow determines how the selected errors will be injected. The user can select a single error or a specific count.
- **Count:** The user will be able to configure the error count via numeric keypad.

Once the test is running, error injection is enabled by selecting the **Error Injection** icon from the action drop-down menu at the top of the screen. Press the **Error Injection** button to inject errors at the predetermined settings.

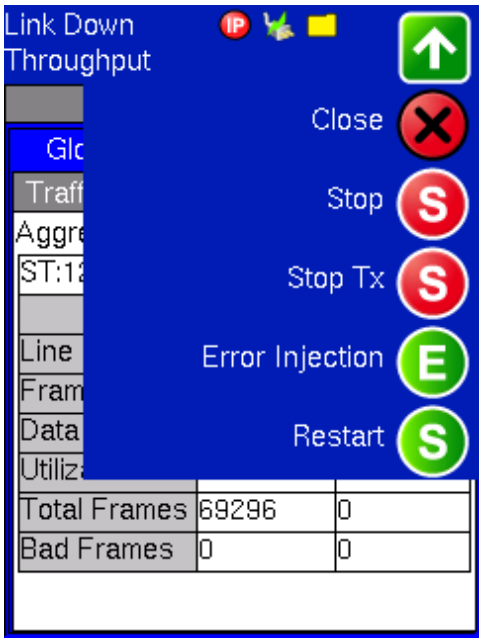
Throughput - Error Inject Setup Stream 1



Throughput - Error Inject Setup Stream 2



Throughput - Error Injection icon



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9.1.6 Starting/Stopping a Throughput Test

Once all the necessary configurations have been made, the user can now start the Throughput test.

Note: If testing on fiber ports, make sure the LASER is turned on before starting the test.

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9.2 Throughput Results

9.2.1 Viewing Test Results (Individual and Multiple Streams)

When the test is first started, the screen automatically changes to the Global/Aggregate results screen.

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9.2.2 Global Results (Multiple Streams)

The Global results pages displays measurements for all traffic streams as well as non test traffic. Aggregate screen displays transmitted and received:

- **Line Rate** (Mbps): Negotiated rate of the interface (10M, 100M, or 1000M). This value is always fixed since it depends on the maximum capacity of the link under test, hence the test interface that is configured.
- **Framed Rate:** (Payload + MAC/IP Header + VLAN Tag + Type/Length + CRC) / (Payload + Total Overhead) * Line Rate % (in Mbps).
- **Data Rate:** Payload / (Payload + Total Overhead) * Line Rate %.
- **Utilization:** % of Line Rate. For example, if we transmit 100Mbps on a 1Gbps interface then the utilization value is 10% (or 100Mbps) of the total link capacity (or Line Rate).
- Total # of frames.
- Total number of bad frames.
- **Optical power:** Optical level measured by the SFP or XFP transceiver.

The **Global Stream Summary** screen displays:

- Stream number (#)
- Total received bandwidth per stream
- Errors/alarms associated with the stream
- Quality of Service (QoS) performance verification associated with each stream

QoS

QoS values are based on packet statistic thresholds for roundtrip delay, jitter, frame loss, and IP checksum from the ITU-T Y.1541 standard. Below is a list of IP network QoS class definitions and network performance objectives from Y.1541.

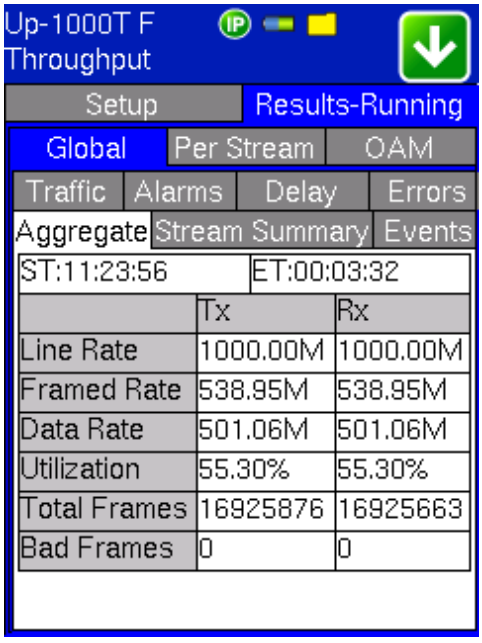
IP Network QoS Class Definitions and Network Performance Objectives (Classes 0-3)

Network Performance Parameter	QoS Classes			
	Class 0	Class 1	Class 2	Class 3
IPTD	≤ 200 ms / 2 (100 ms one-way)	≤ 800 ms / 2 (400 ms one-way) **AND** > 200 ms/2	≤ 200 ms / 2 (100 ms one-way)	≤ 800 ms / 2 (400 ms one-way) **AND** > 200 ms/2
IPDV	≤ 50 ms	≤ 50 ms	U	U
IPLR	> 1/100,000 **AND** ≤ 1/1000	> 1/100,000 **AND** ≤ 1/1000	> 1/100,000 **AND** ≤ 1/1000	> 1/100,000 **AND** ≤ 1/1000
IPER	> 1 / 1,000,000 **AND** ≤ 1/10,000	> 1 / 1,000,000 **AND** ≤ 1/10,000	> 1 / 1,000,000 **AND** ≤ 1/10,000	> 1 / 1,000,000 **AND** ≤ 1/10,000

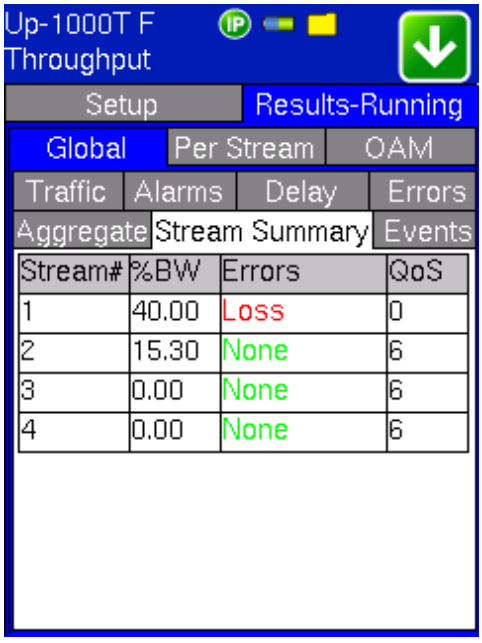
IP Network QoS Class Definitions and Network Performance Objectives (Classes 4-7)

Network Performance Parameter	QoS Classes			
	Class 4	Class 5	Class 6	Class 7
IPTD	≤ 2 s / 2 (1 s one-way) **AND** > 800 ms /2	U	≤ 200 ms / 2 (100 ms one-way)	≤ 800 ms / 2 (400 ms one-way) **AND** > 200 ms/2
IPDV	U	U	≤ 50 ms	≤ 50 ms
IPLR	> 1/100,000 **AND** ≤ 1/1000	U	≤ 1 / 100,000	≤ 1/100,000
IPER	> 1 / 1,000,000 **AND** ≤ 1/10,000	U	≤ 1 / 1,000,000	≤ 1/1,000,000

Throughput Results - Global Aggregate



Throughput Results - Stream Summary



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The **Global Errors** screen displays the Current and Total error count of all streams:

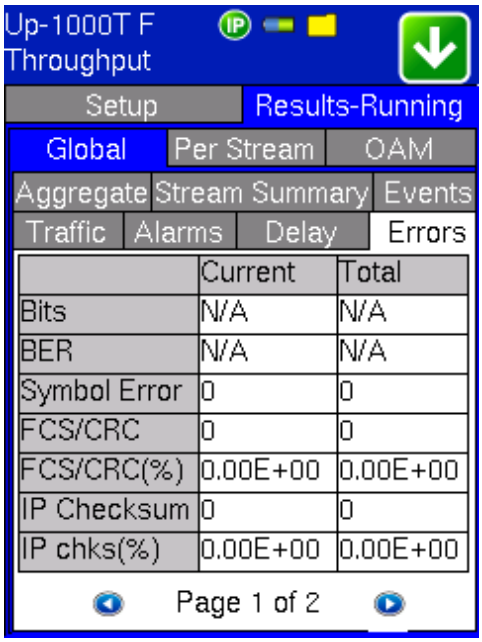
- **Bit:** Indicates errors related to test pattern (Bit Error or LSS [Pattern Loss])
- **BER:** Bit Error Ratio
- **Symbol:** Declared when an invalid code-group in the transmission code is detected
- **FCS/CRC:** Number of received frames with an invalid Frame Check Sequence (FCS)
- **IP Checksum:** Invalid IP Frame Check sequence
- **IP chks(%)**
- **Jabber frames:** Number of received frames larger than 1518 bytes containing an invalid FCS
- **Runt frames:** Number of received frames smaller than 64 bytes containing an invalid FCS

- **Giant frames:** Number of received frames larger than 1522 bytes containing an invalid FCS

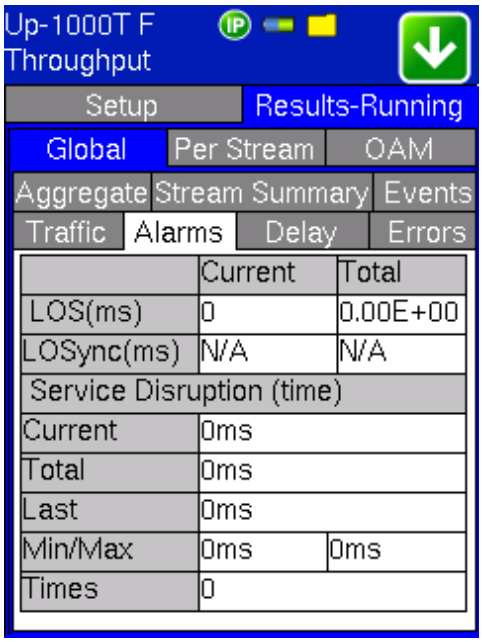
The **Global Alarms** screen displays the Current and Total alarm count of all streams:

- **LOS:** Loss of Signal
- **LOS Sync:** Loss synchronization
- Service disruption associated with loss of signal:
  - **Current:** Duration of the current service disruption
  - **Total:** Total accumulated duration of the service disruptions
  - **Min/Max:** Minimum and maximum duration of the service disruption events
  - **Times:** Counter of service disruption events

Throughput Results - Global Errors



Throughput Results - Global Alarms



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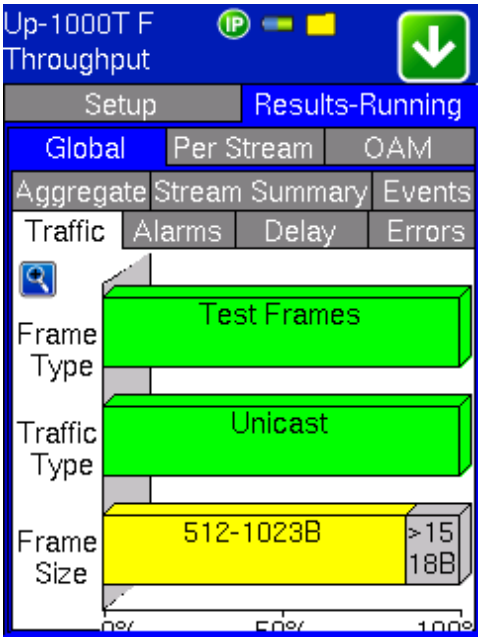
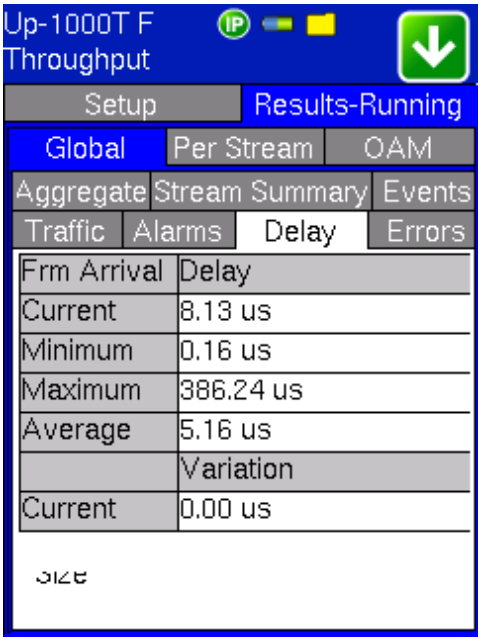
The **Global Traffic** screen displays:

- Frame Type of all streams
- Traffic Type(s) of all streams
- Frame size of all streams

Throughput Results - Global Traffic Summary



Throughput Results - Global Stream Delay



For more information on Traffic results, please see 7.2.5 BERT Traffic.

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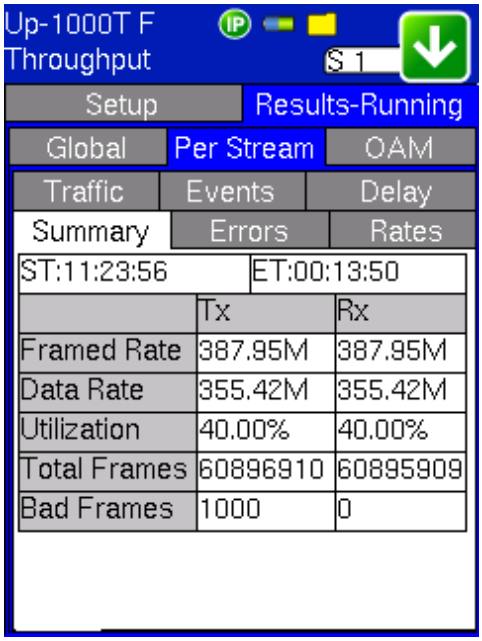
9.2.3 Individual Stream Results

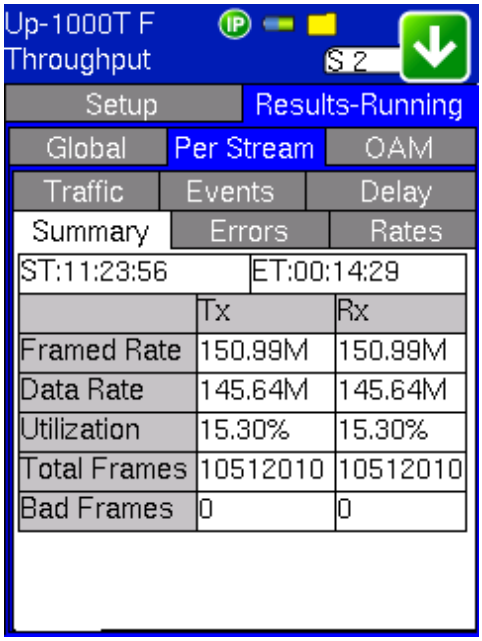
The Per Stream traffic pages, display the statistics for each traffic stream configured in the throughput test. Tap on the stream number (S#) in the top right corner to navigate to a different stream. The **Per Stream** tab displays the following measurements:

- **Summary:** Framed rate, data rate, # of bytes, total # of frames associated with each stream
- **Errors:** Errors associated with each stream
- **Events:** Events associated with each stream
- **Traffic:** Traffic statistics associated with each stream
- **Delay:** Delay associated with each stream
- **Rates:** Rates information associated with each stream

Throughput Results - Summary Stream 1



Throughput Results - Summary Stream 2



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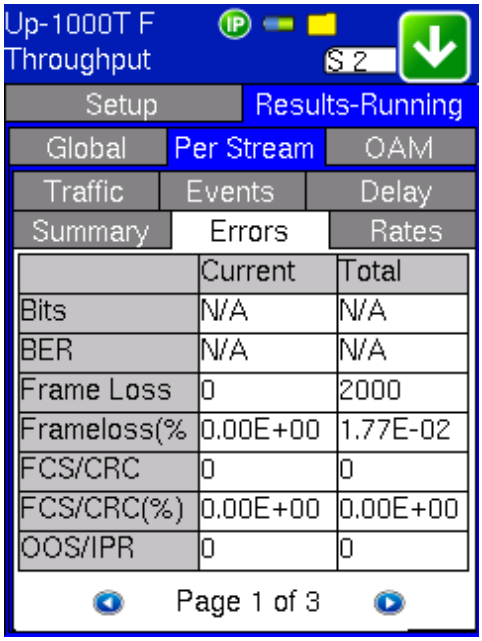
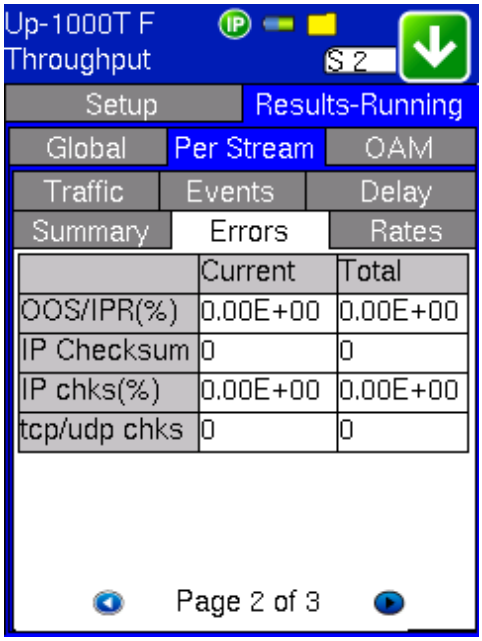
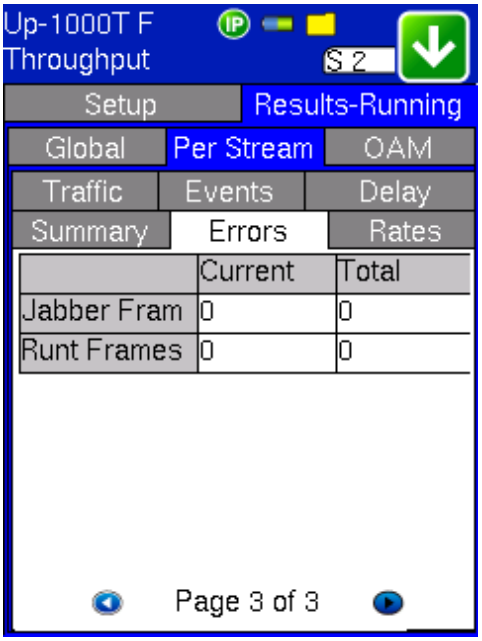
The **Per Stream Errors** screen displays the current and total error count of **Per Stream Errors**. Please see 7.2.2 BERT Errors for more information.

Throughput Results - Errors (Page 1) **Throughput Results - Errors (Page 2)** **Throughput Results - Errors (Page 3)**







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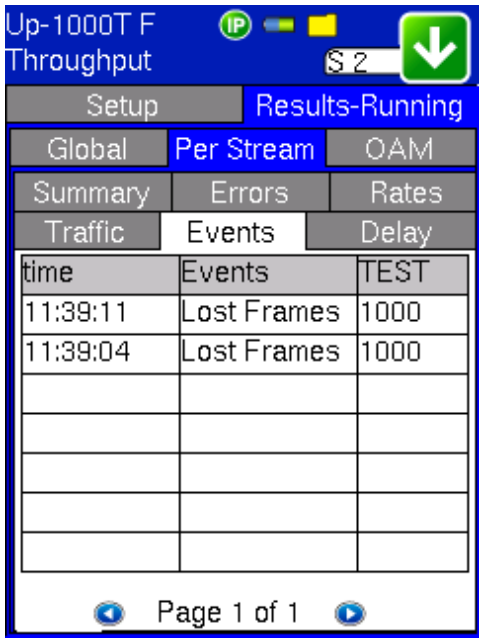
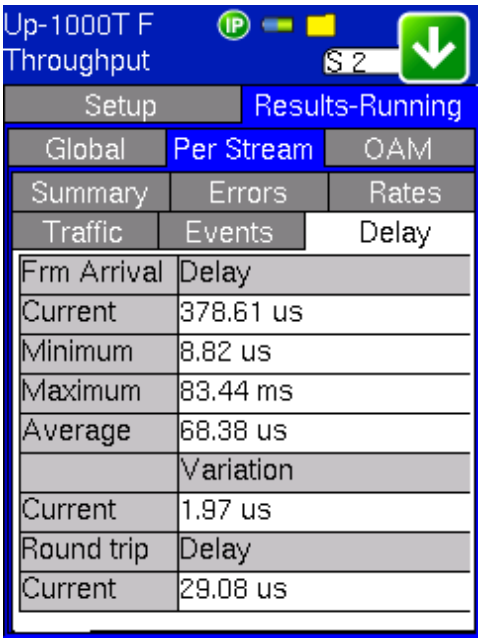
The **Per Stream Events** screen displays a Date and Time stamped record of bit errors, alarms and other anomalies pertaining to each stream.

The **Per Stream Delay** screen displays the frame delay information pertaining to each stream.

Throughput Results - Events per Stream



Throughput Results - Delay per Stream



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The **Per Stream Traffic** screen displays the frame type summary (graphical), frame type (tabular) and frame size distribution pertaining to each stream.

Frames tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- **Received (Rx) Frames**:
  - Total frames
  - Test frames (frames containing VeEX proprietary tags)
  - VLAN tagged frames

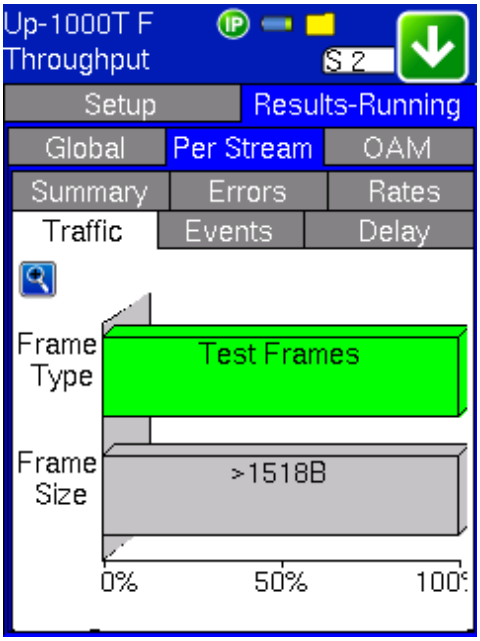
- **Transmitted (Tx) Frames**:

- Total frames - Total # frames transmitted

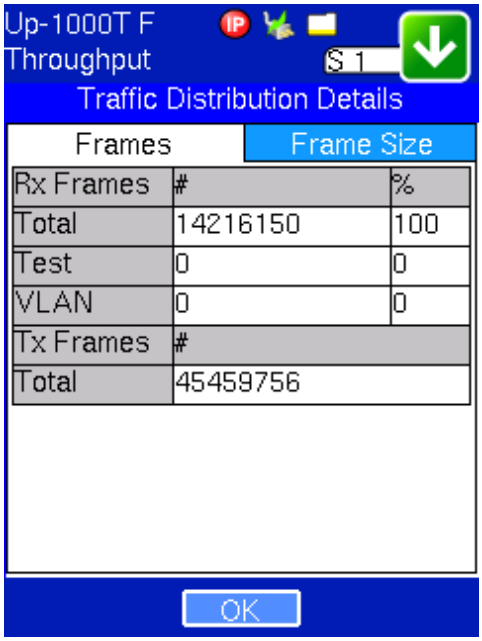
Frame Size tab: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- < 64 byte frames
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames
- 1280-1518 byte frames
- > 1518 byte frames - Jumbo frames

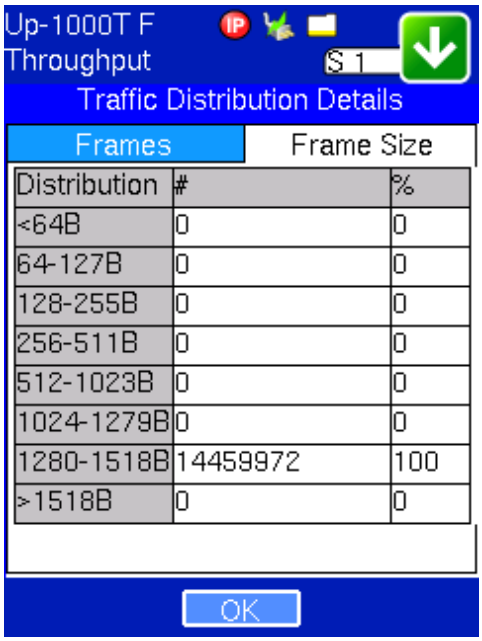
Throughput Results
Traffic Overview Per Stream



Throughput Results
Frame Types Per Stream



Throughput Results
Frame Size Per Stream



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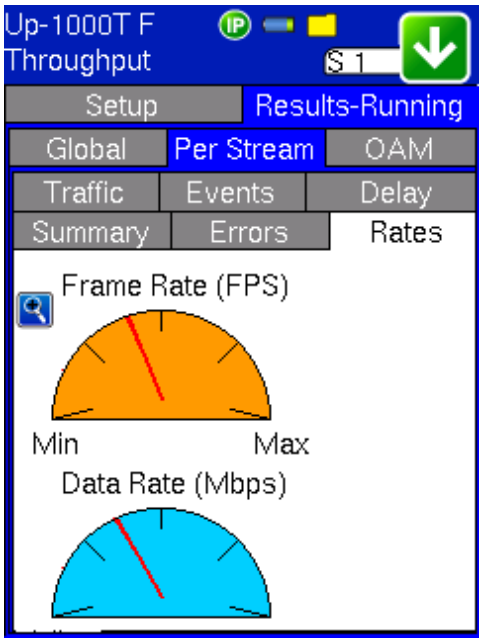
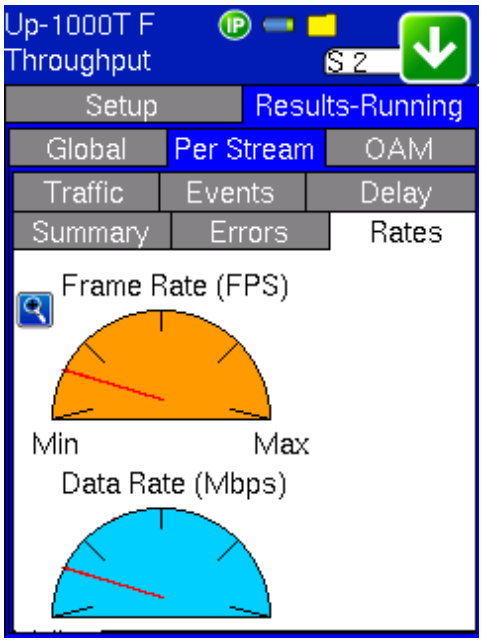
The **Per Stream Rate** screen displays the frame rate and data rate pertaining to each stream. Tapping the zoom icon displays the

rate details applicable to that stream.

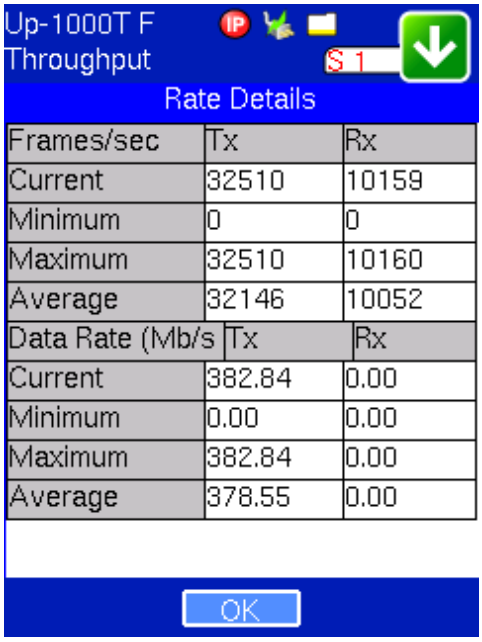
Throughput Results - Rates Stream 1



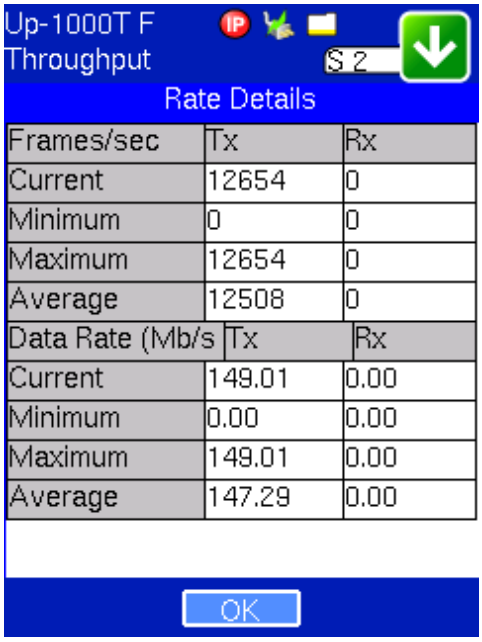
Throughput Results - Rates Stream 2



Rate Details Stream 1



Rate Details Stream 2



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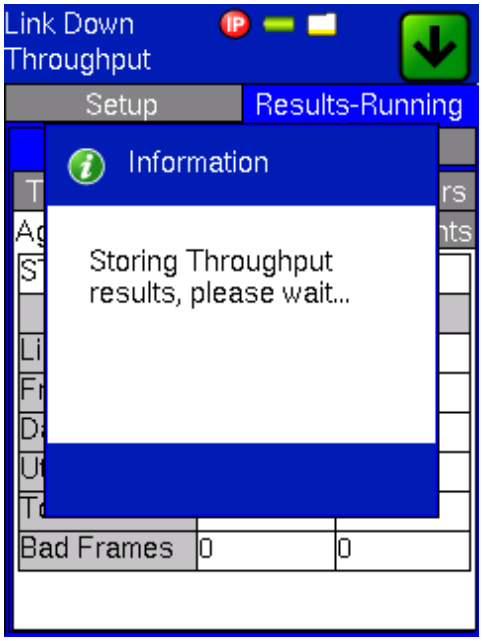
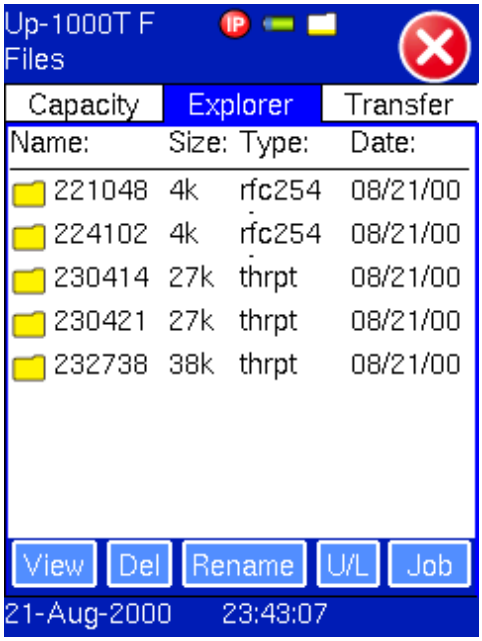
9.2.4 Saving Throughput Results

To save test results, press the store button during or after testing. The test results are saved and named automatically. Once saved, the user may view or rename the results file by going to the Explorer tab located in the Files menu.

Throughput Results - Storage Warning

Stored Throughput Results - File Explorer





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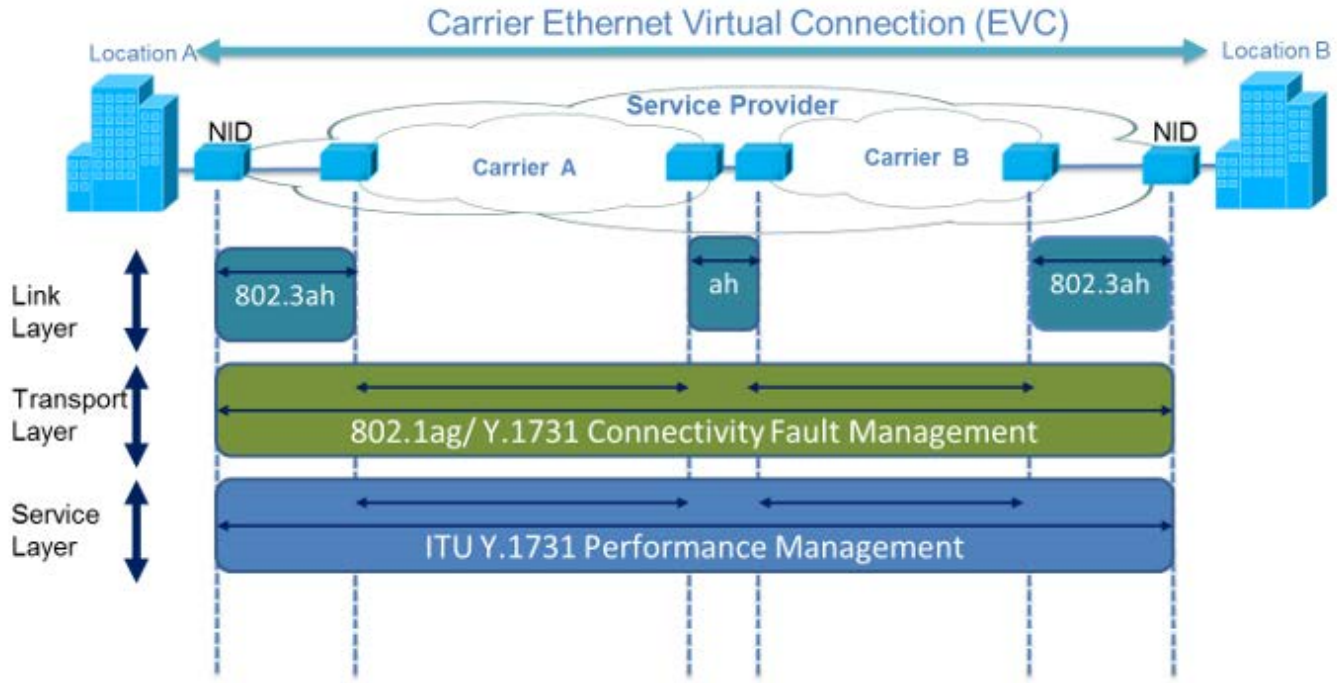
10.0 OAM Testing



Ethernet OAM provides automatic defect detection, fault management and performance monitoring tools for network links and end-to-end Ethernet Virtual Circuits (EVC). The OAM service supports IEEE 802.3ah, IEEE 802.1ag, and ITU-T Y.1731. The OAM feature can be accessed through the Throughput menu (**Throughput** > **Setup** > **OAM**).

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10.1 OAM Setup

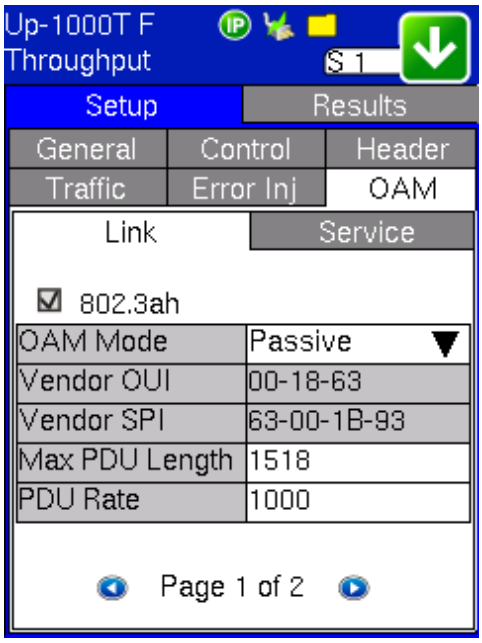
10.1.1 Link Level 802.3ah OAM Setup

802.3ah functions include:

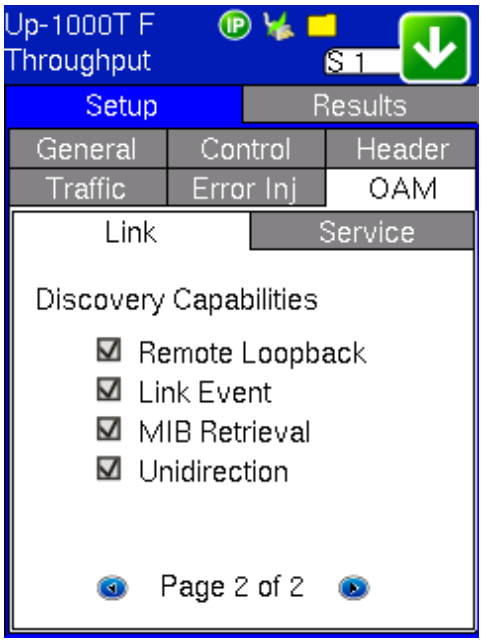
- Discovery
- Link Performance Monitoring

- Remote loopback
- Fault detection
- Collecting Performance Statistics (function not supported in current software release)
- Organizational Specific Extensions (function not supported in current software release)

Link OAM Setup (Page 1)



Link OAM Setup (Page 2)



- **802.3ah OAM**: Tap on the check box to start 802.3ah protocol testing. Transmission of OAM PDUs starts as soon as the box is checked.

- **OAM Mode:** Select Active or Passive mode from the drop-down menu. Active and passive mode determines the type of actions the test set will take. For more on acceptable Active/Passive mode combinations and actions, see section 10.3.1 802.3ah OAM Discovery.

- **Vendor OUI and SPI**: Organization Unique identifier and Vendor specific information (similar to MAC address fields).

- **Max PDU Length**: Advertised Max OAM PDU size (64 to 1518). After Discovery, the lowest of the local and remote will be used.

- **PDU Rate:** 100 to 10000 ms between consecutive OAM PDUs.

- **Discovery Capabilities:** Enables OAM enabled devices to exchange their OAM capabilities, configuration, and identity to link partners. Check on the boxes to advertise selected capabilities during Discovery. ***Note:*** *Each device can be placed in any mode as long as the remote and local device are not both in passive mode.*
  - **Remote Loopback:** The user can transmit a loopback command to place the remote unit into loopback mode. Every frame received is transmitted back on the same port to ensure the quality of links during installation or troubleshooting and for fault isolation testing.
  - **Link Events:** Supported, but not stateful
  - **MIB Retrieval:** Can be advertised but is not supported in current release
  - **Unidirection:** Checks for unidirectional transmission.

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10.1.2 Service Level OAM: 802.1ag/Y.1731 Setup

The user has the option of starting the 802.1ag or Y.1731 test.

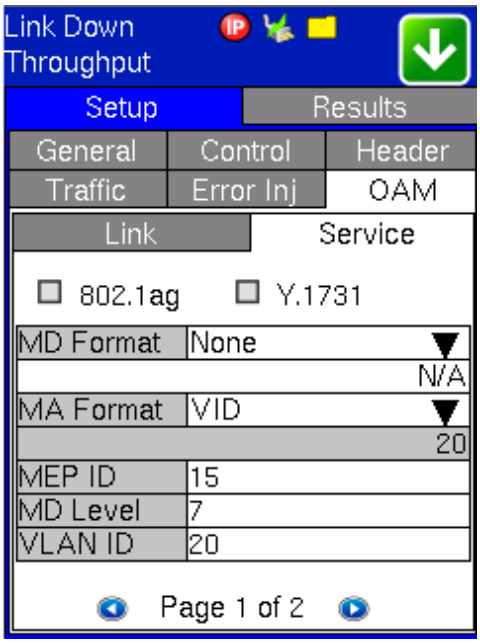
1. Fill out the given parameters.
   Note: MD Format, ***MA Format***, ***MEP ID, VLAN ID***, *and* ***MD Level*** *input values must match for both connected OAM devices in order for the tests to work. The* ***Remote MEPID*** *and* ***MEP ID*** *must also be inverted for the tests to work.*

2. Tap the box next to 802.1ag or Y.1731 to start the selected test. The transmission of OAM PDUs become active as soon as the check mark is added to the test.
   Note: *The different test options become available only when either 802.1ag or Y.1731 is selected. Once either is selected Page 3 and 4 are also displayed with the test options.*

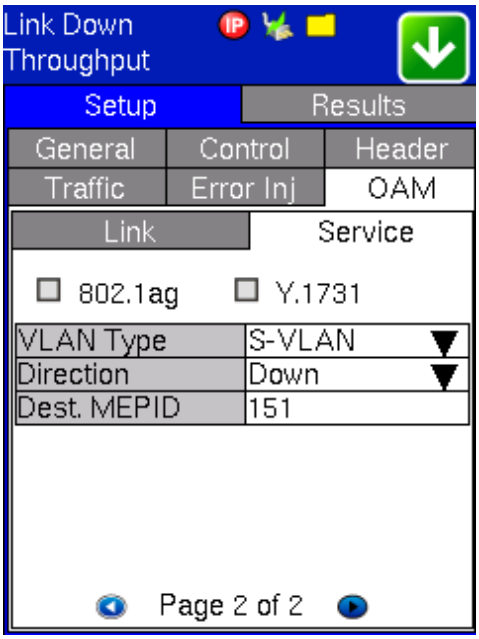
3. Select the available test options on Page 3 and 4.
   For 802.1ag the following are available:
   Continuity Check Messages (CCM), Loopback Message (LBM) and Link Trace Message (LTM)
   For Y.1731 the following are available:
   Continuity Check Messages (CCM), Loopback Message (LBM), Link Trace Message (LTM), Frame Loss (LM) and Delay (DM).

4. Tap **Start** to start the test.

OAM Service Level (Page 1)



OAM Service Level (Page 2)



Service Level OAM Configuration Parameters (see section 10.3 Definitions for more details)

Page 1:

- **MD Format:** Configure the format of the Maintenance Domain name
  - **None:** Null field. No maintenance domain name present
  - **MAC+2octet:** User configurable MAC address + 2 octets
  - **String:** User configurable ASCII character string
- **MA Format:** Configure the format of the Maintenance Association name
  - **VID:** User configurable VLAN ID, as configured in the Primary VLAN ID level
  - **String:** User configurable ASCII character string
  - **2 octet:** 2 octet integer
  - **ICC-Based:** User configurable ITU-T Y.1731 ITU Carrier Code (ICC) based
- **MD Level:** Maintenance domain level. 0 to 7.
- **MEP ID:** End point identifier of local device. 1 to 8191.
- **VLAN ID:** VLAN ID associated with the MA or MEG.

Page 2:

- **VLAN Type:** C-VLAN or S-VLAN
- **Direction**
  - **Up:** Inward facing MEP used for MA/MEG with a wider reach (i.e., end-to-end, beyond a single link).
  - **Down:** Outward facing MEP used for MA/MEG spanning a single link.
- **Dest MEP ID:** MEP ID of the MEP end point.

Page 3:

- **CCM**
  - **Enable:** Enable sending Continuity Check messages
  - **Disable:** Disable sending Continuity Check messages
- **Priority:** 802.1p priority in the CCM VLAN Tag
- **Tx Interval:** Choose from the supported CCM intervals: 1 s, 10 s, 1 min, 10 min

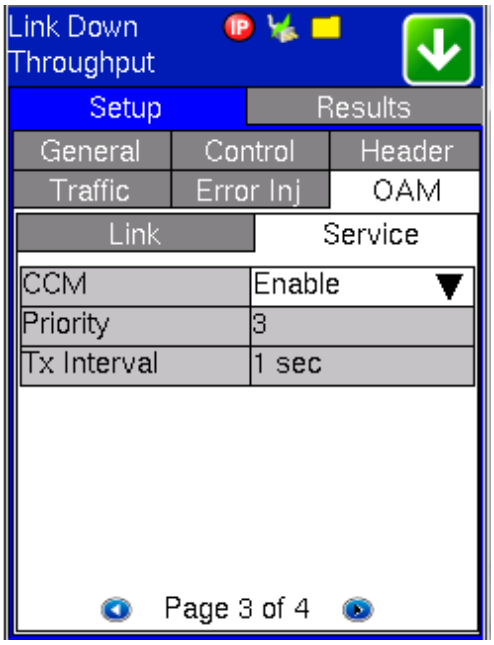
Page 4 (802.1ag):

- **Test Function:** LTM / LBM
- **Destination**
  - **MEP:** Sends LTM/LBM to the destination MEP as configured on Page 1.
  - **MAC:** Sends LTM/LBM to a destination MAC address.
- **Destination MAC** - Configure the destination MAC address used for the LTM/LBM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- **Priority:** 802.1p priority in the LTM/LBM VLAN Tag.
- **# Messages:** Enter the number of Loopback messages to be sent (LBM test only).
- **TTL:** Enter the Time to Live field in the LTM message. TTL will be decremented each time it crosses a hop (MIP) (LTM test only).

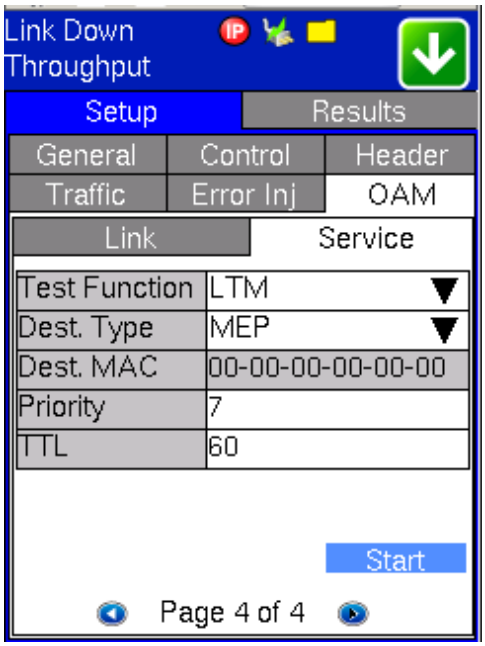
Page 4 (Y.1731):

- **Test Function:** LTM / LBM / LMM / DMM
- **Destination**
  - **MEP:** Sends LMM/DMM to the destination MEP as configured on Page 1.
  - **MAC:** Sends LMM/DMM to a destination MAC address.
- **Destination MAC:** Configure the destination MAC address used for the LMM/DMM. This field is only used if Destination is set to MAC. If destination is set to MEP, this field is ignored.
- **Priority:** 802.1p priority in the LMM/DMM VLAN Tag.
- **# Send:** Configure the number of LMM/DMM frames to send up to 50.
- **Rate :** Configure the LMM/DMM frame interface rate (min: 100 ms; max: 10 seconds).

OAM Service Level (Page 3)



OAM Service Level (Page 4)



Differences between 802.1ag and Y.1731

Selecting **802.1ag** enables Continuity Check Messages (CCM), Loopback Message (LBM) and Link Trace Message (LTM). **ITU-T Y.1731** provides all of the 802.1ag functionality with additional performance monitoring capabilities including Frame Loss (LM) and Delay (DM).

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802.1ag/Y.1731 Connectivity Fault Management Functions

802.1ag/Y.1731 Functions supported are as listed:

- Fault Detection – Continuity Check:
  - CCM "heartbeat" messages are transmitted at a configurable periodic interval by MEPs.
- Network/Path Discovery – Link trace message:
  - Equivalent to a "traceroute" test. MIPs and MEPs along the path send a response.
- Fault verification and isolation – Loopback:
  - Verify connectivity to a specific point in the message. Equivalent to "ping" test.

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Frame Loss Measurement

Two local counters for each peer MEP:

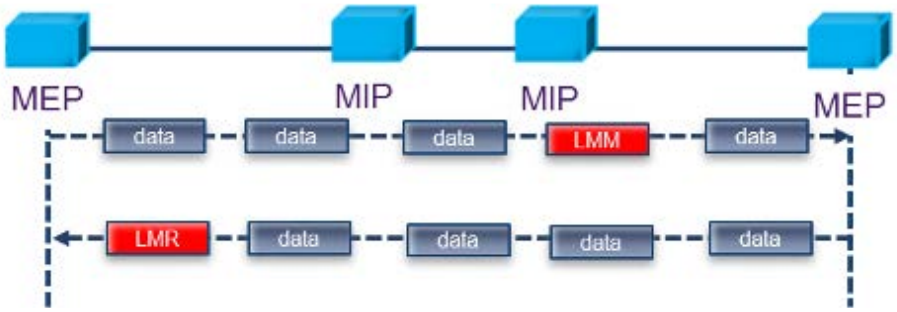
- TxFCf: Counter for in-profile data frames transmitted towards peer MEP
- RxFCf: Counter for in-profile data frames received from peer MEP

Single-ended ETH-LM:

- On demand OAM
- MEP sends LMM frame (Unicast DA or Multicast Class 1 DA) and receives LMR frame (Unicast DA) with counters

CCM frames contain frame counters.

Single Ended Frame Delay Measurement



LMM frames contain frame counters.

Delay Measurement

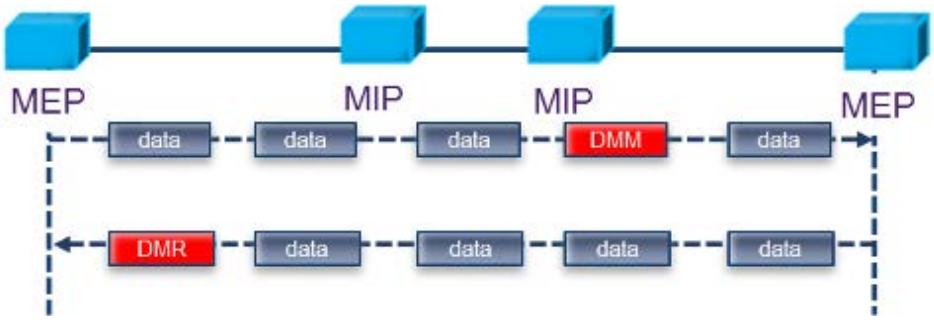
On demand OAM for measuring Frame Delay (FD) and Frame Delay Variation (FDV):

- TxTimeStampf = Timestamp transmission of DMM frame
- RxTimef = Reception time of the DMM frame
- RxTimeb = Reception of DMR frame

Two-way ETH-DM:

- DMM frame (Unicast DA or Multicast Class 1 DA for multipoint measurement) & DMR frame (Unicast DA)
- FD = RxTimeb – TxTimeStampf

Dual Ended Frame Delay Measurement



DMM and DMR frames contain timestamp info.

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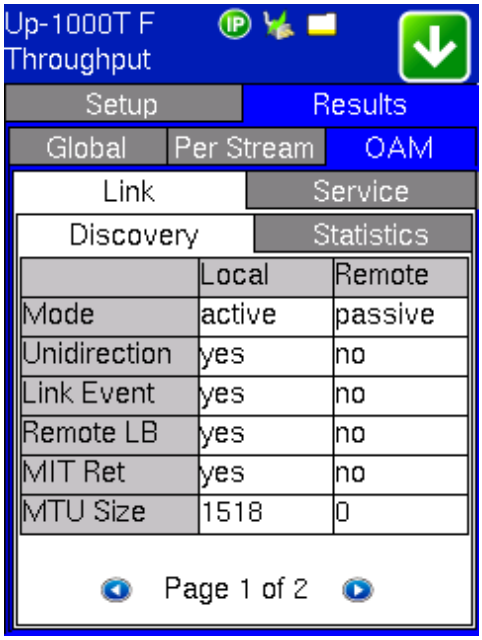
10.2 OAM Results

10.2.1 Link OAM Results

Link OAM Discovery

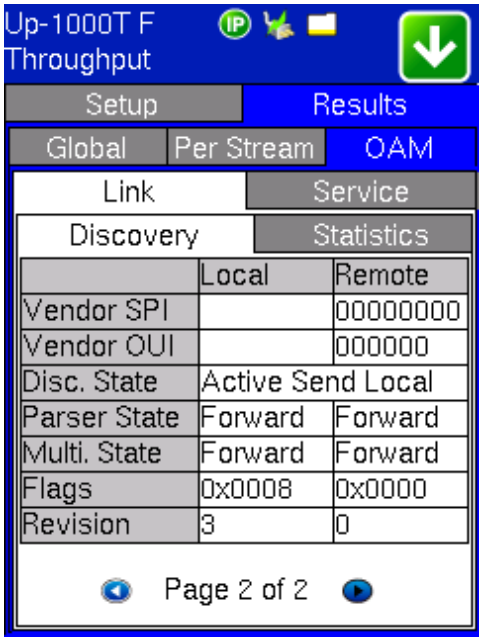
The discovery page lists **Local** (the current test unit) and **Remote** (far-end device) parameters.

OAM - Link - Discovery (Page 1)



- **Mode:** Lists Active or Passive mode configuration.
- Supported and unsupported capabilities advertised during Discovery are listed, including: Unidirection, Link Events, Remote Loopback, MIB Retrieval, and MTU Size.

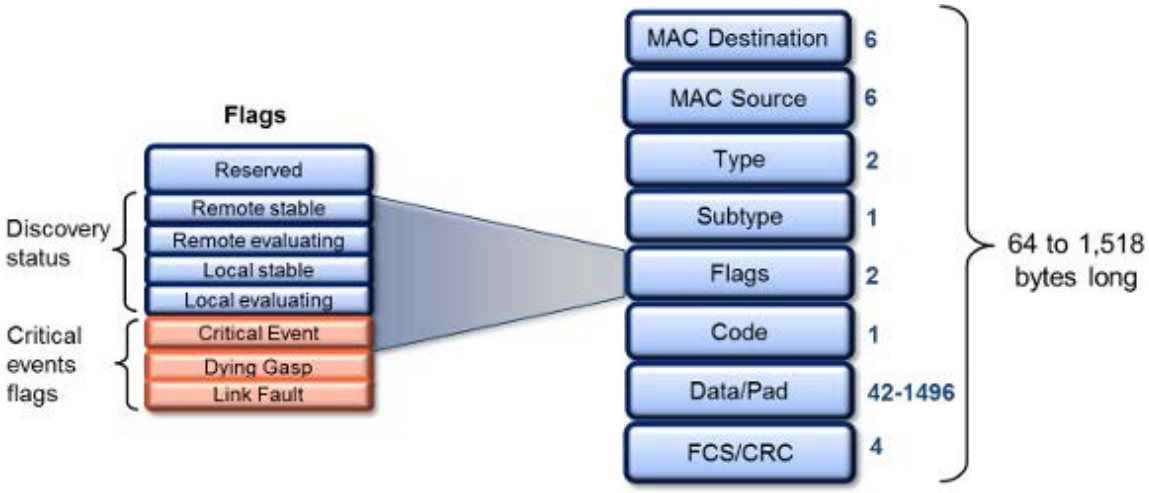
OAM - Link - Discovery (Page 2)



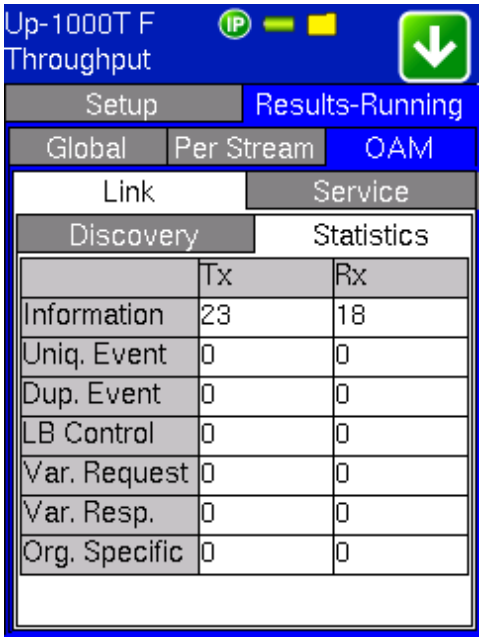
	Local	Remote
Vendor SPI		00000000
Vendor OUI		000000
Disc. State	Active Send Local	
Parser State	Forward	Forward
Multi. State	Forward	Forward
Flags	0x0008	0x0000
Revision	3	0

- **Vendor SPI and OUI:** Organization Unique identifier and Vendor specific information (similar to MAC address fields).
- **Discovery State:** Send Any indicates the device was successfully discovered.
- **Parser/Multiplexer state:** Forward indicates the device is forwarding regular traffic transmission. **Loopback/drop** indicates loopback is enabled.
- **Flags:** Flag decode is listed in the graphic below.
- **Revision:** Number of times the configuration has been modified since discovery.

Flag Decode



OAM - Service - CCM



OAM PDU

Transmitted and received 802.3ah OAM PDU are displayed with other Link OAM statistics:

- **Information:** Information OAM PDU acts as a "heart beat" message. Discovery must be restarted if no OAM PDU is received after 5 seconds.
- **Unique** and **Duplicate** Events are Threshold crossing events not supported in the current software release.
- Number of **Loopback Control** frames.
- **Variable Request** and **Response** are MIB query messages not supported in the current software release.

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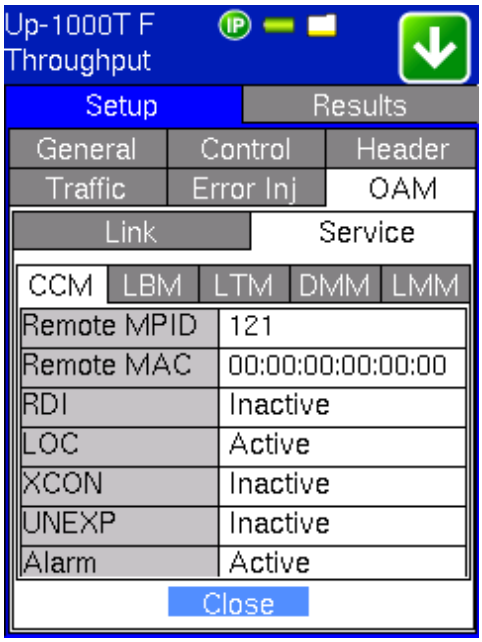
10.2.2 OAM Service Results

802.1ag/Y.1731 Connectivity Fault Management Functions Results

OAM - Service - CCM

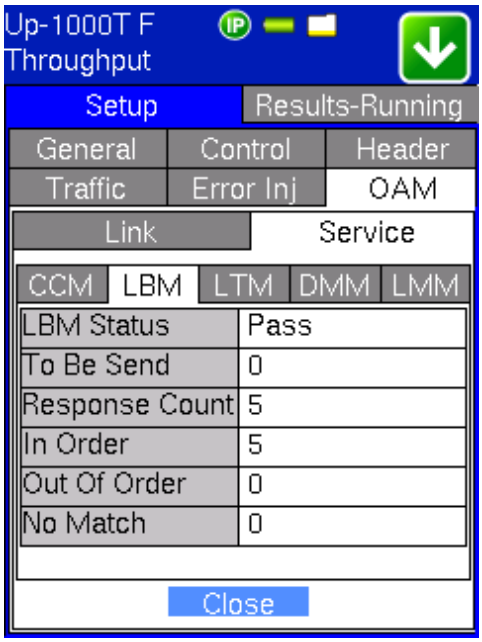


OAM CCM Results

RDI, **LOC**, **XCON**, **UNEXP**, and **Alarm** will display an **Inactive** or **Active** status.

- **Remote MPID:** MEP ID of the remote MEP.
- **Remote MAC:** MAC address of the remote MEP.
- **RDI:** The CCM received contains the RDI flag set.
- **LOC:** The MEP detects loss of connectivity.
- **XCON:** Possible cross-connect, the CCM received could be from another MA.
- **UNEXP:** Unexpected MEP ID or non matching CCM interval.
- **Alarm:** A fault alarm is triggered if a defect is present for a time period of 10s. The fault alarm is cleared if a defect condition is not present for a time period of 10s.

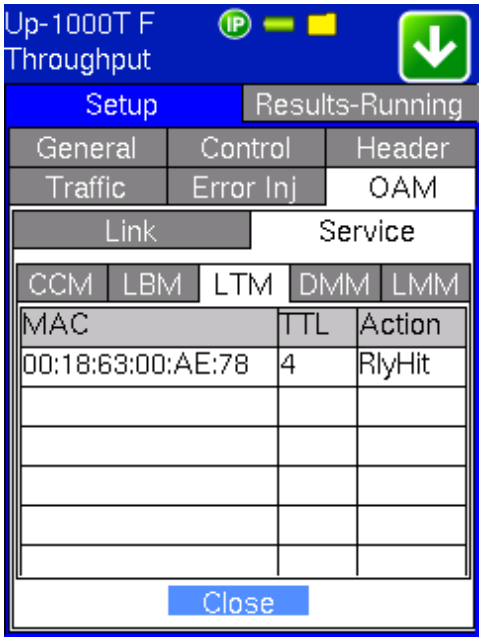
OAM - Service - LBM



OAM LBM Results

- **LBM Status**
  - **Pass:** At least 1 Loopback response received
  - **Fail:** No Loopback responses received
- **To be Send:** Outstanding number of LBM to be sent
- **Response Count**
- **In Order:** Number of LBR received in order
- **Out of Order:** Number of LBR received out of order
- **No Match:** The loopback transaction ID between the LBM and LBR do not match

OAM - Service - LTM



OAM LTM Results

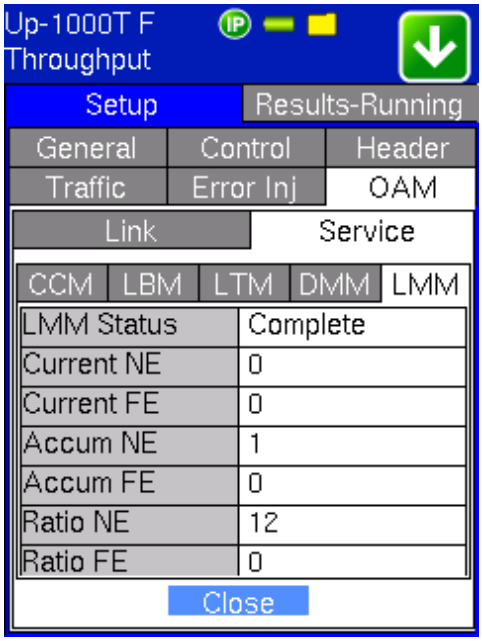
- **Action:** RlyHit indicates that the LTM has reached the destination MAC/MEP (i.e., final point)
- **MAC:** MAC address of the responder
- **TTL:** TTL field on the response, indicated how many hops have been traversed
- **Flags:** If set, indicates that only MAC addresses learned in a Bridge's Filtering Database, and not information saved in the MIP CCM Database, is to be used to determine the Egress Port

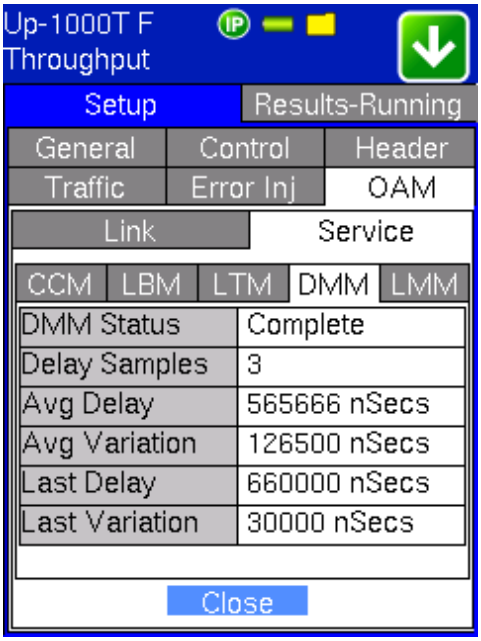
Y.1731 Performance Management Functions Results

OAM LMM Parameters

Parameter	Near End	Far End
Current	Value of the current number frames lost in the receive direction	Value of the current number of frames lost in the transmit direction
Accumulation	Total number of frames lost in the receive direction	Total number of transmitted frames lost in the transmit direction
Ratio	Percentage of frames lost in the receive direction	Percentage of frames lost in the transmit direction

OAM - Service - LMM **OAM - Service - DMM**





NE=Near End device
FD=Far-End device

OAM DMM Parameters

- **DMM Status:** Lists status: In progress, Fail, or Complete
- **Delay Samples:** Number of frames transmitted
- **Average Delay:** Average round trip delay over the number of delay samples
- **Average Variation:** Average round trip delay variation over the number of delay samples
- **Last Delay:** Last round trip delay value measured
- **Last Variation:** Last round trip delay variation value measured

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10.3 Definitions

10.3.1 802.3ah OAM Discovery

Discovery is the first phase of the 802.3ah protocol. During Discovery, local and remote units exchange Information OAM PDUs indicating capabilities and configuration information (e.g., mode, PDU size, loopback support, etc.). After successful negotiation, the OAM protocol is enabled on the link. If no OAM PDU is received after 5 seconds, Discovery is restarted. The device can be configured in Active or Passive mode combinations.

OAM Mode Active/Passive Action

Action	Mode Passive	Mode Active
Initiates OAM discovery	No	Yes
Responds to OAM discovery	Yes	Yes
Peer must be in active mode	Yes	Yes
Sends Information OAM PDU	Yes	Yes
Sends Event Notification OAM PDU	Yes	Yes
Sends Variable Request OAM PDU	No	Yes
Sends Loopback Control	No	Yes
Reacts to Loopback Control	Yes	Yes

OAM Mode - Acceptable Active/Passive Combinations

	Local Active	Local Passive
Remote Active	Yes	Yes
Remote Passive	Yes	No

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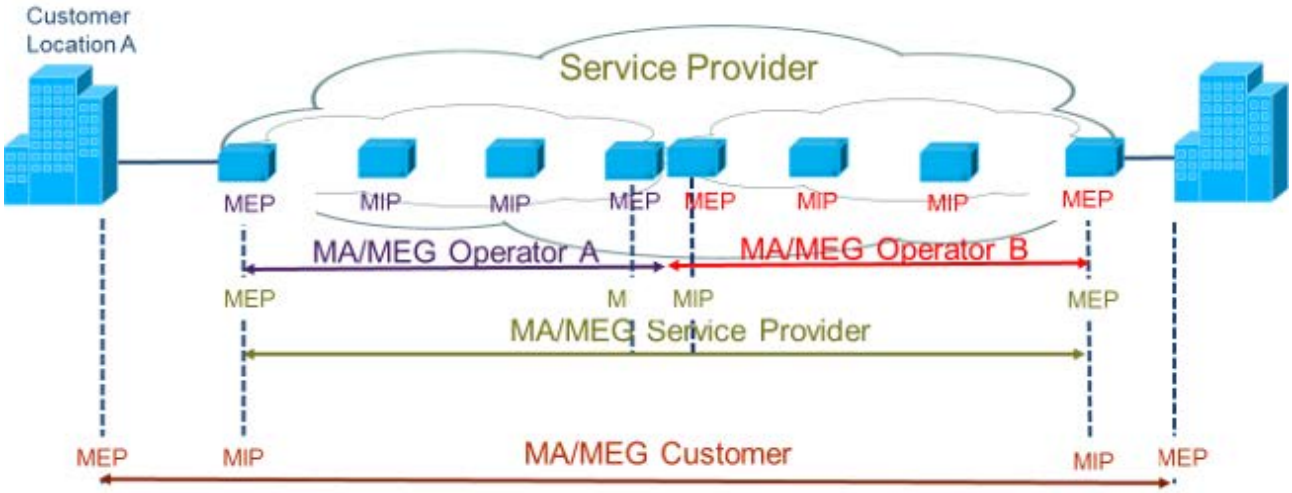
10.3.2 IEEE 802.1ag Definitions

- **Maintenance Domain (MD):** Management space on a network that is owned and operated by a single network provider. There is a maintenance level (from 0 to 7) to define the hierarchical relationship between domains. Maintenance domains can be nested but never intersect. MD is defined by Operational or Contractual Boundaries (e.g., Customer, Service Provider, Operator).
- **Maintenance Association (MA):** Association of Maintenance. Elements that comprise the Maintenance domain.
- Maintenance Elements can either be MEPs (End Points) or MIPs (Intermediate Points):
  - MEPs are at the edge of the network. They can generate and respond to OAM messages. A point-to-point EVC has only 2 MEPs, a multi-point EVC has multiple MEPs.
  - MIPs are located between the MEPs and can be used to isolate network problems. MIPs cannot generate OAM messages but can respond.
- **Maintenance Level:** Identifies the network hierarchy. Higher Level = Largest network. Level information present in all OAM PDU frames.
  - Level 0,1,2 = Operator domain
  - Level 3,4 = Service Provider domain
  - Level 5,6,7 = Customer domain



Some terms differ between the two protocols. The chart below describes the differences.

Definition Equivalencies

IEEE 802.1ag	ITU Y.1731
Maintenance Domain (MD)	No equivalent
Maintenance Association (MA)	Maintenance Entity Group (MEG)
Maintenance End Point (MEP)	Maintenance Entity Group End Point (MEP)
Maintenance Intermediate Point (MIP)	Maintenance Entity Group Intermediate Point (MIP)

Maintenance Point Roles

Function	MEP	MIP
Initiates CCM messages	Yes	No
Initiates Loopback and Linktrace messages	Yes	No
Responds to Loopback and Linktrace messages	Yes	Yes
Y.1731 Performance Management messages (AIS,LCK, TST,LM, etc) initiates and responds	Yes	No
Forwards messages	Yes (upper maintenance layer) No (lower maintenance layer)	Yes (upper maintenance layer) No (lower maintenance layer)

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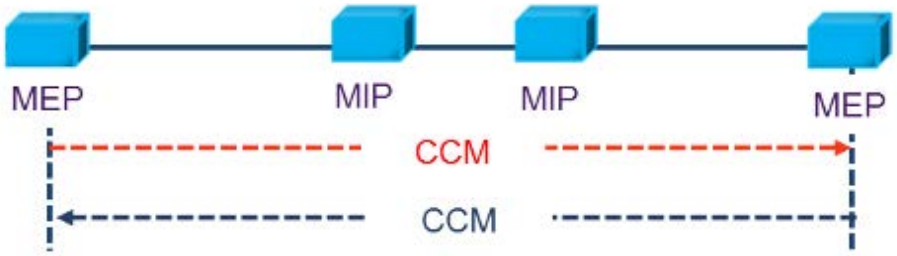
10.3.3 Measurement Definitions

Continuity Check Messages (CCM)

CCM Messages are multicast messages sent from MEP to MEP at configurable intervals. Loss of continuity is detected after no CCM is received for 3.5 times the CCM interval.

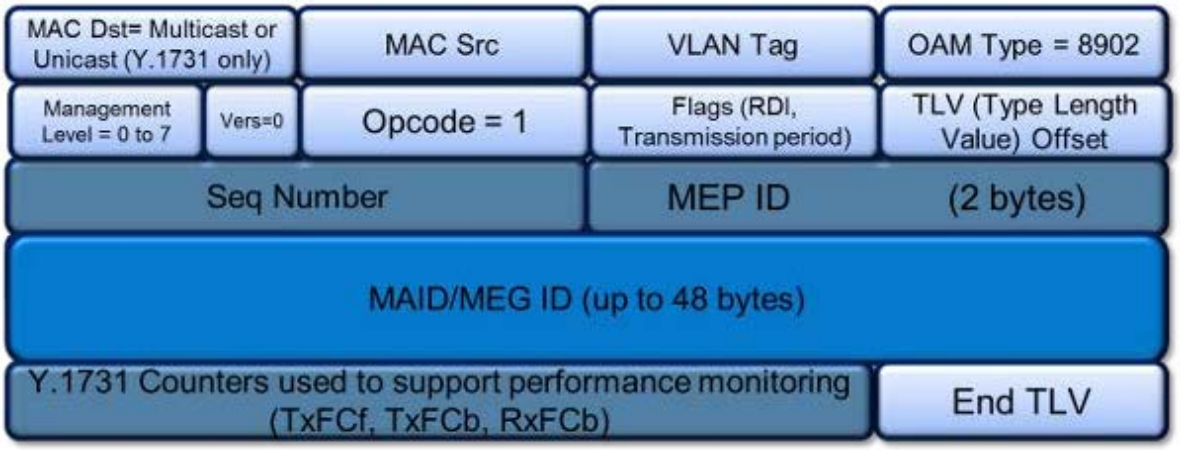
***Note**: There can be 4,094 VLANs per port and up to eight maintenance levels. This yields a worst case CCM transmission rate of 9.8 million CCMs per second if 3.3ms interval is used.*

Continuity Check Message (CCM)



RDI Flags added in CCM Messages indicates loss of continuity in the remote direction.

CCM Message Format



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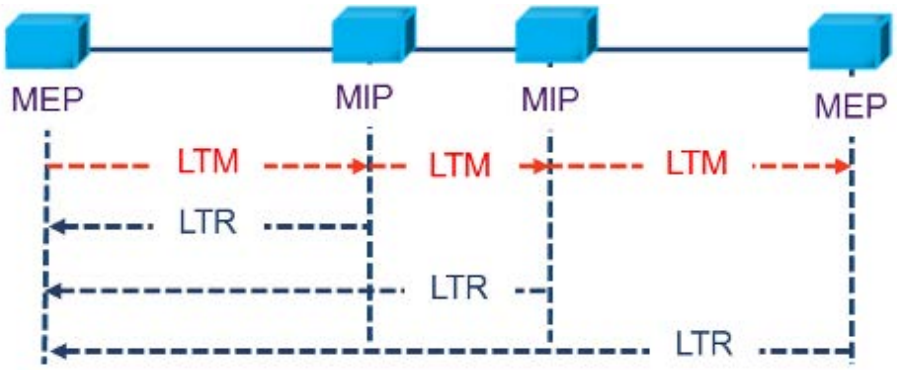
Link Trace Messages (LTM/LTR)

LTM (Link Trace Message) Multicast messages are transmitted on demand to a destination MAC address. All MIPs and destination MEPs respond with LTR (Link Trace Reply) and forward the LTM on to its destination.

LTM Diagram



Link Trace Message Format

Link Trace Response Format

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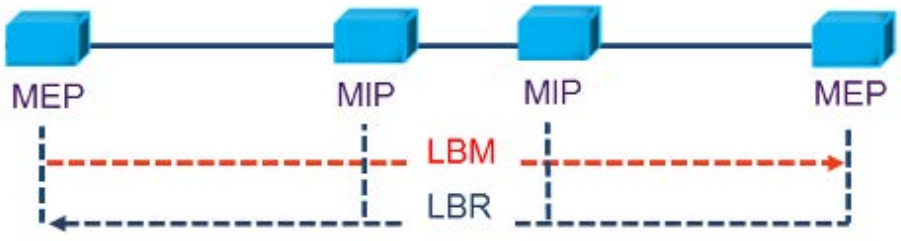
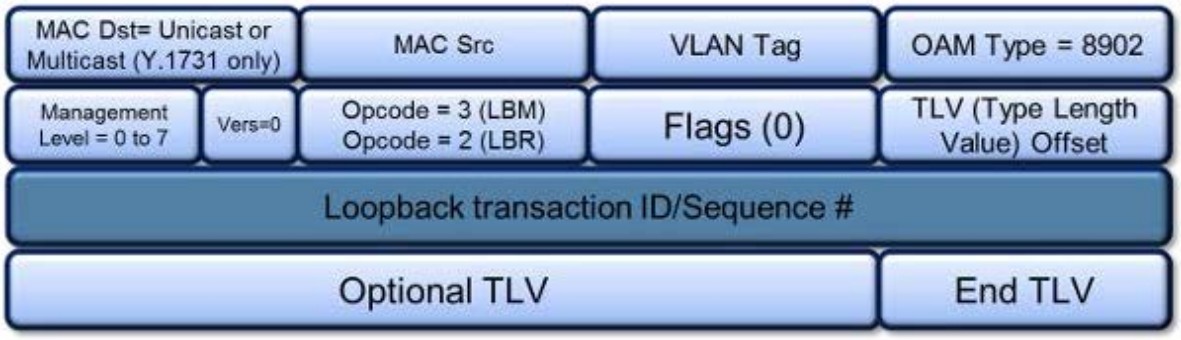
Loopback Message (LBM/LBR)

LBM (Loopback Message) are unicast messages transmitted on demand to a destination MAC address. A destination address responds with an LBR (Loopback Reply Message).

LBM Diagram



Loopback Message Format



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11.0 Monitor Mode - Pass Through (MX120e+ only)

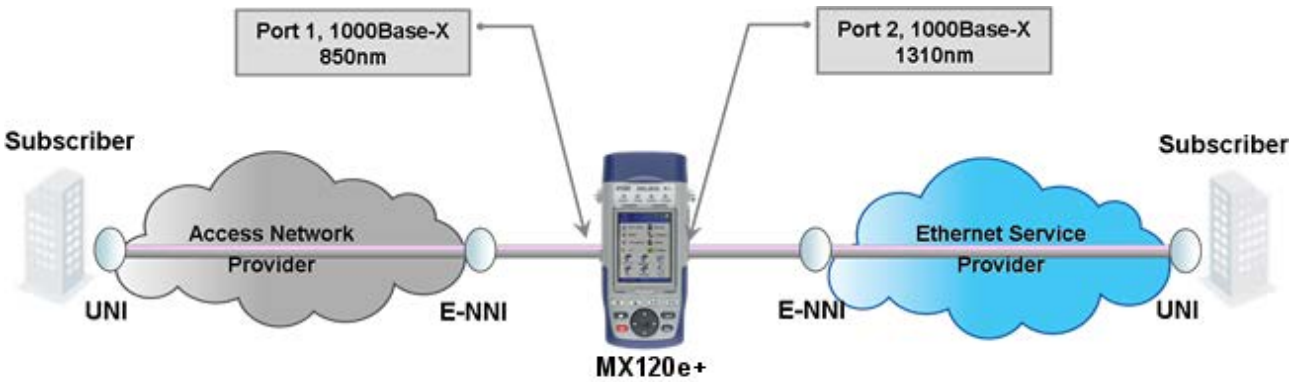
Overview: Pass through monitor mode enables the test set to be used for long term in-service testing. This allows for bidirectional non-obtrusive monitoring of up to full gigabit Ethernet line rate on the two 1000Base-X ports or the two 10/100/1000T ports.

The Pass Through functionality allows:

- In-line traffic monitoring in both directions
- Long or short term network monitoring for troubleshooting network traffic problems
- Isolate network problems to the customer network or the service provider/operator network
- Monitor traffic between 1000Base-X links or 10/100/1000T links

- **Pass through monitor operation**
  - Pass Through Monitor Copper 1GE
  - Pass Through Monitor Fiber 1GE
  - Pass through monitor mode enables bidirectional monitoring between the two 1000Base-X ports or the two 10/100/1000Base-T ports.

MX120e+ - Bidirectional Monitoring Test Application



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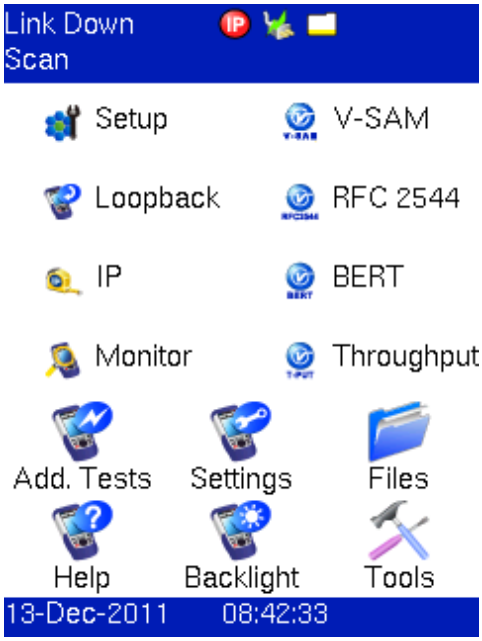
11.1 Setup

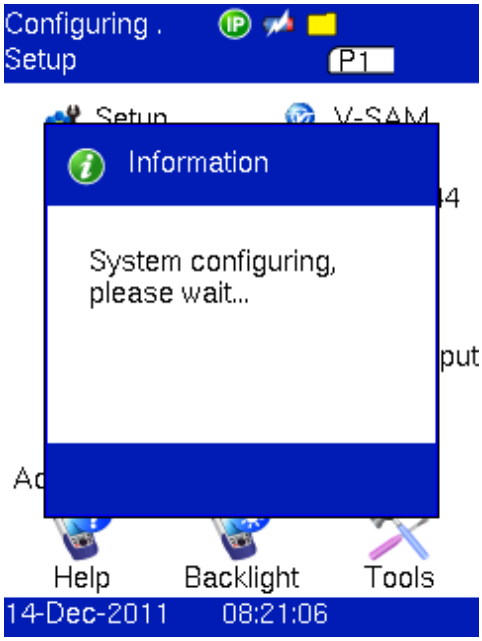
The pass through monitor setup and operation is straight forward and simple:

- Select Monitor from the Main Menu - the unit will take a few moments to configure.
- Connect both 1000Base-X fiber ports (Port 1 and Port 2) or both 10/100/1000T copper ports (Port 1 and Port 2), depending on the interfaces to be monitored.

Monitor Mode Menu

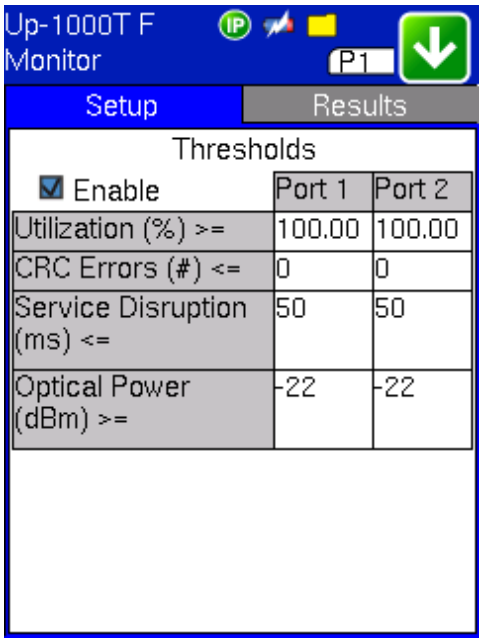


Monitor Mode Configuration

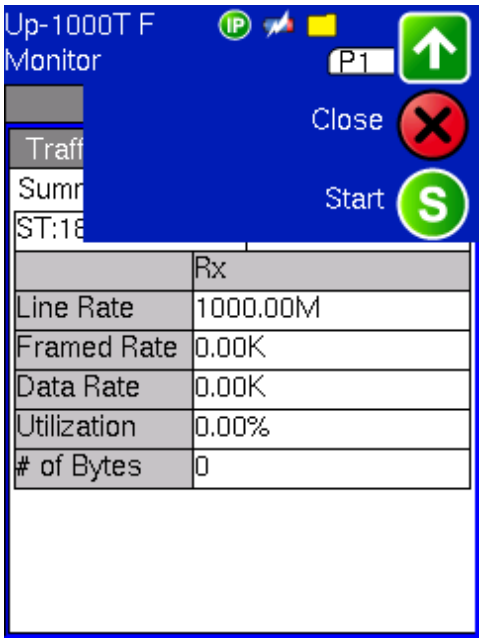


- Thresholds: Set values for Port 1 and Port 2. Thresholds can be enabled or disabled. When enabled, the pass through will show a Pass/Fail status based on the configured threshold values.
  - Utilization in %
  - CRC error count
  - Service Disruption in ms
  - Optical Power level in dBm (1000Base-X connections only)
- Once the cable/interface connections are in place, and the thresholds have been set, select and press **Start** from the drop-down menu.

Monitor Mode - Threshold Setup



Monitor Mode - Starting Measurement



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11.2 Results

11.2.1 Errors

The following Errors (Current and Total) are displayed:

- **FCS/CRC:** Number of received frames with an invalid FCS
- **IP Checksum** (Layer 3 only)
- **Jabber frames:** Number of received frames larger than 1518 bytes containing an invalid FCS
- **Runt frames:** Number of received frames smaller than 64 bytes containing an invalid FCS
- **Giant frames:** Number of received frames larger than 1522 bytes containing an invalid FCS

Note: A flashing red tab indicates an anomaly has occurred.

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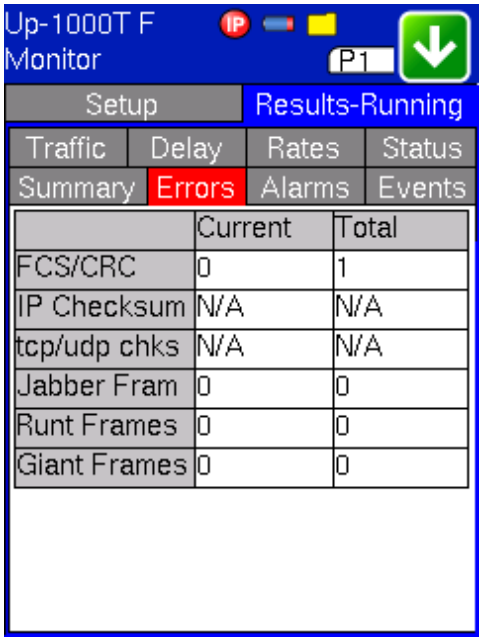
11.2.2 Alarms

The following Alarms (Current and Total) are displayed:

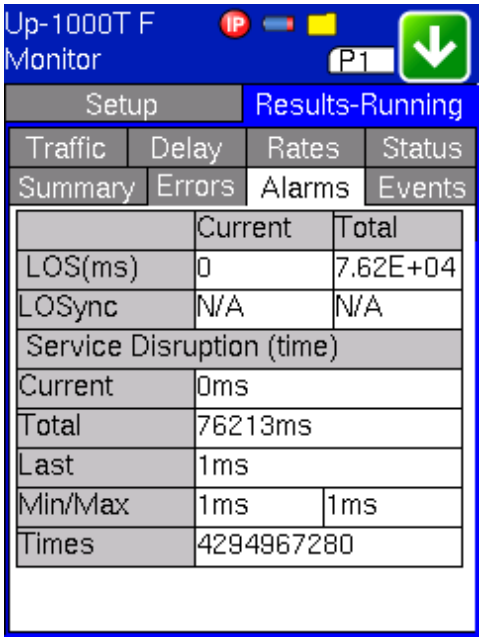
- **LOS:** Loss of Signal
- **LOS Sync:** Loss synchronization
- **Pattern Loss:** Indicates errors related to test pattern
- Service disruption associated with loss of signal:
  - **Current:** Duration of the current service disruption
  - **Total:** Total accumulated duration of the service disruptions
  - **Min/Max:** Minimum and maximum duration of the service disruption events
  - **Times:** Counter of service disruption events

Monitor Mode - Errors



	Current	Total
FCS/CRC	0	1
IP Checksum	N/A	N/A
tcp/udp chks	N/A	N/A
Jabber Fram	0	0
Runt Frames	0	0
Giant Frames	0	0

Monitor Mode - Alarms



	Current	Total
LOS(ms)	0	7.62E+04
LOSync	N/A	N/A
Service Disruption (time)		
Current	0ms	
Total	76213ms	
Last	1ms	
Min/Max	1ms	1ms
Times	4294967280	

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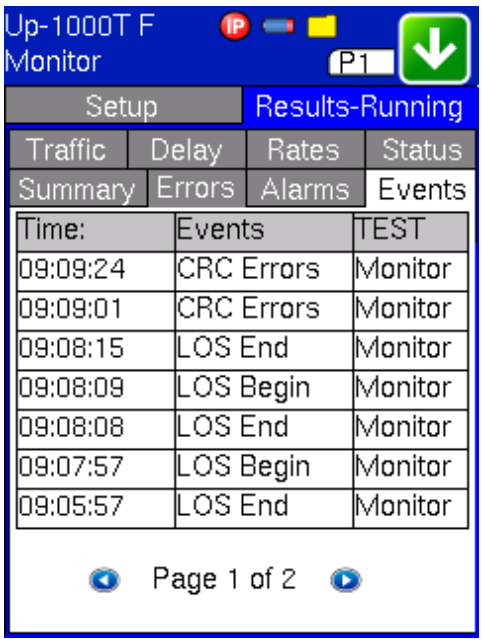
11.2.3 Events and Status

A time stamped record or log of anomalies, alarms, test status (start/stop) and test application are displayed. When Thresholds are enabled, a Pass or Fail value is displayed for each of the following parameters:

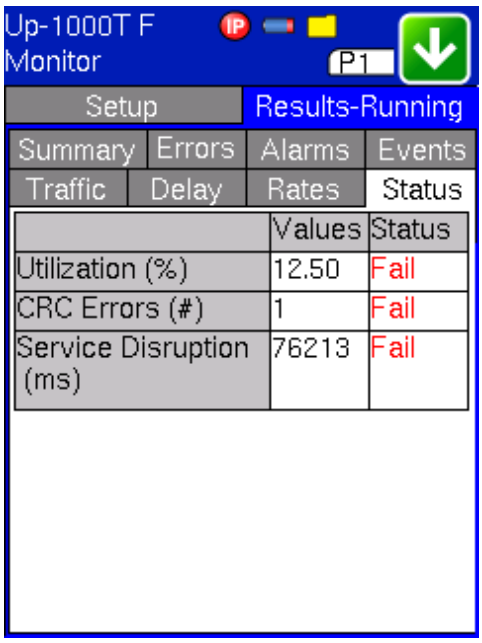
- Utilization %
- CRC Errors count
- Service Disruption in ms
- Optical Power level in dBm (1000Base-X / fibre connections only)

Pass/Fail criteria is based on the configured threshold values. If the thresholds are not enabled, no status will display (only measurement values).

Monitor Mode - Events



Monitor Mode - Status



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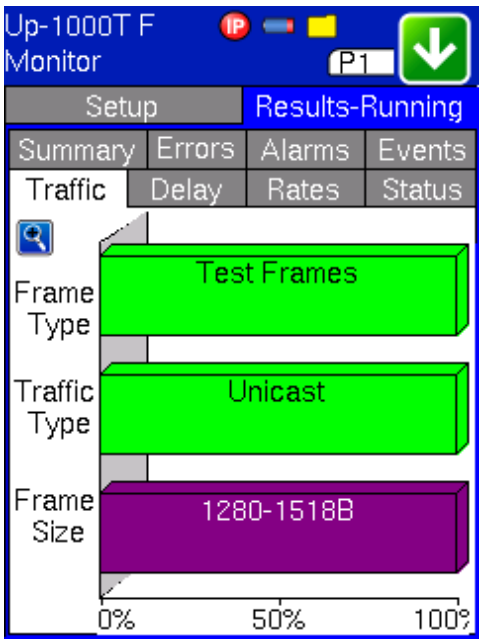
11.2.4 Traffic Distribution Details

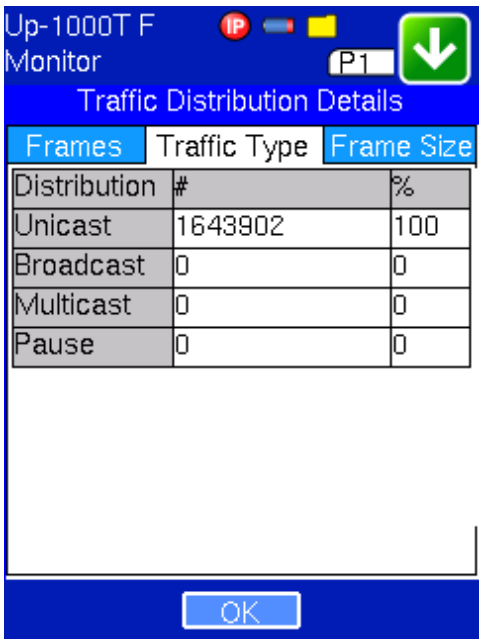
Traffic Type: The following Traffic distribution statistics are displayed in Count (#) and Percentage (%):

- **Unicast frames:** Number of Unicast frames received without FCS errors.
- **Broadcast frames:** Number of Broadcast frames received without FCS errors. Broadcast frames have a MAC address equal to FF-FF-FF-FF-FF-FF.
- **Multicast frames:** Number of Multicast frames received without FCS errors.
- **Pause frames:** Number of valid flow-control frames received. Frames having a type/length field equal to 8808h are counted as pause frames.

Monitor Mode - Traffic Overview



Monitor Mode - Traffic Type



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Frames: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- **Received (RX) frames:**

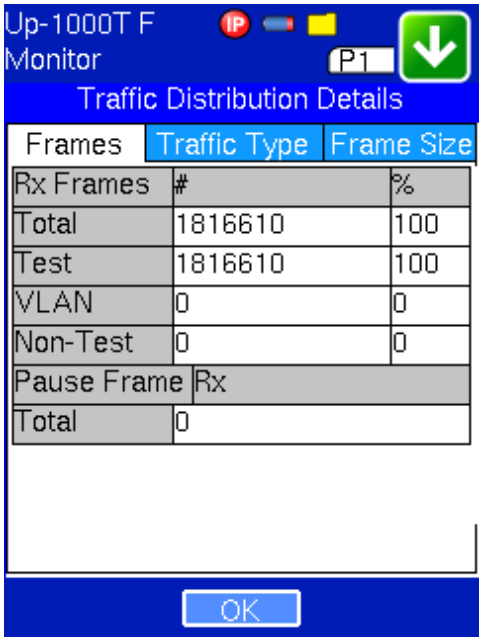
Total frames
- Test frames
- VLAN tagged frames
- VLAN stacked frames
- MPLS labeled frames
- MPLS stacked frames
- Non-test frame

- **Paused frames**: Received

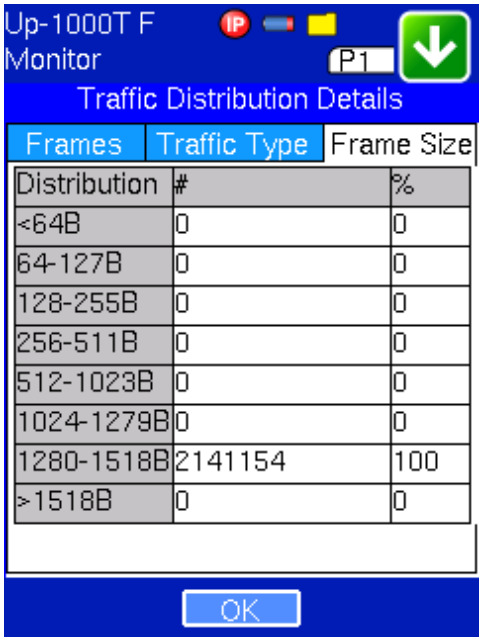
Frame Size: The following Frame distribution statistics are displayed in Count (#) and Percentage (%):

- < 64 byte frames
- 64-127 byte frames
- 128-255 byte frames
- 256-511 byte frames
- 512-1023 byte frames
- 1024-1279 byte frames
- 1280-1518 byte frames
- > 1518 byte frames - Jumbo frames

Monitor Mode - Frames



Monitor Mode - Frame Size



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11.2.5 Delay and Rates

Delay: Frame arrival statistics are displayed in tabular format:

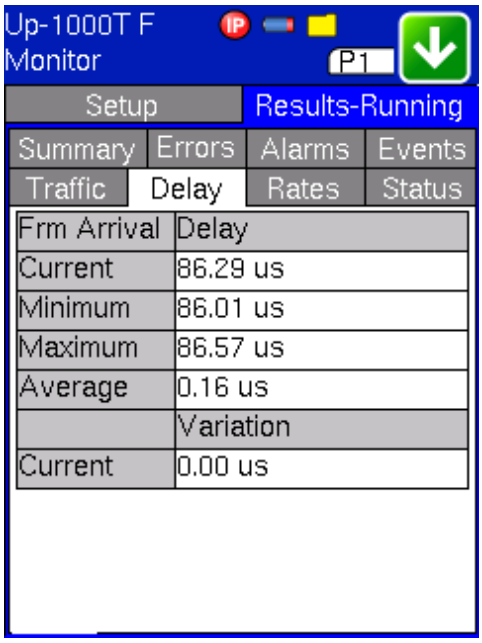
- Current
- Minimum
- Maximum
- Variation (Current)

Rates: Rate statistics are displayed in tabular format:

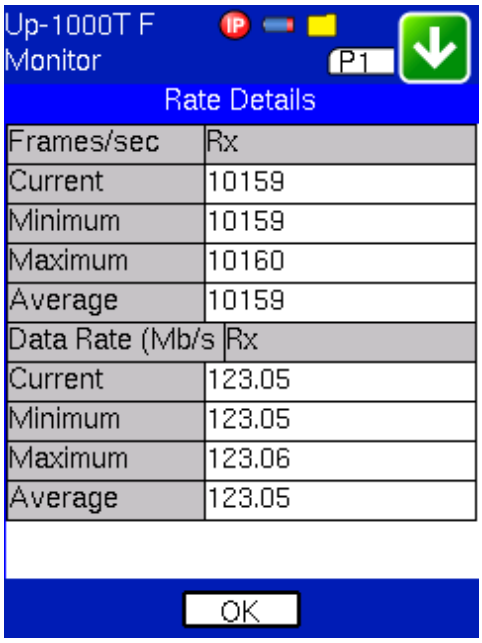
- Frame rate in Frames per Second (FPS)
  - Current (number of received frames including bad frames, broadcast frames and multicast frames)
  - Minimum
  - Maximum
  - Average
- Data rate in Mbps: Received data rate expressed in Mbps
  - Current (number of received frames including bad frames, broadcast frames and multicast frames)

- Minimum
- Maximum
- Average

Monitor Mode - Delay



Monitor Mode - Rate Details



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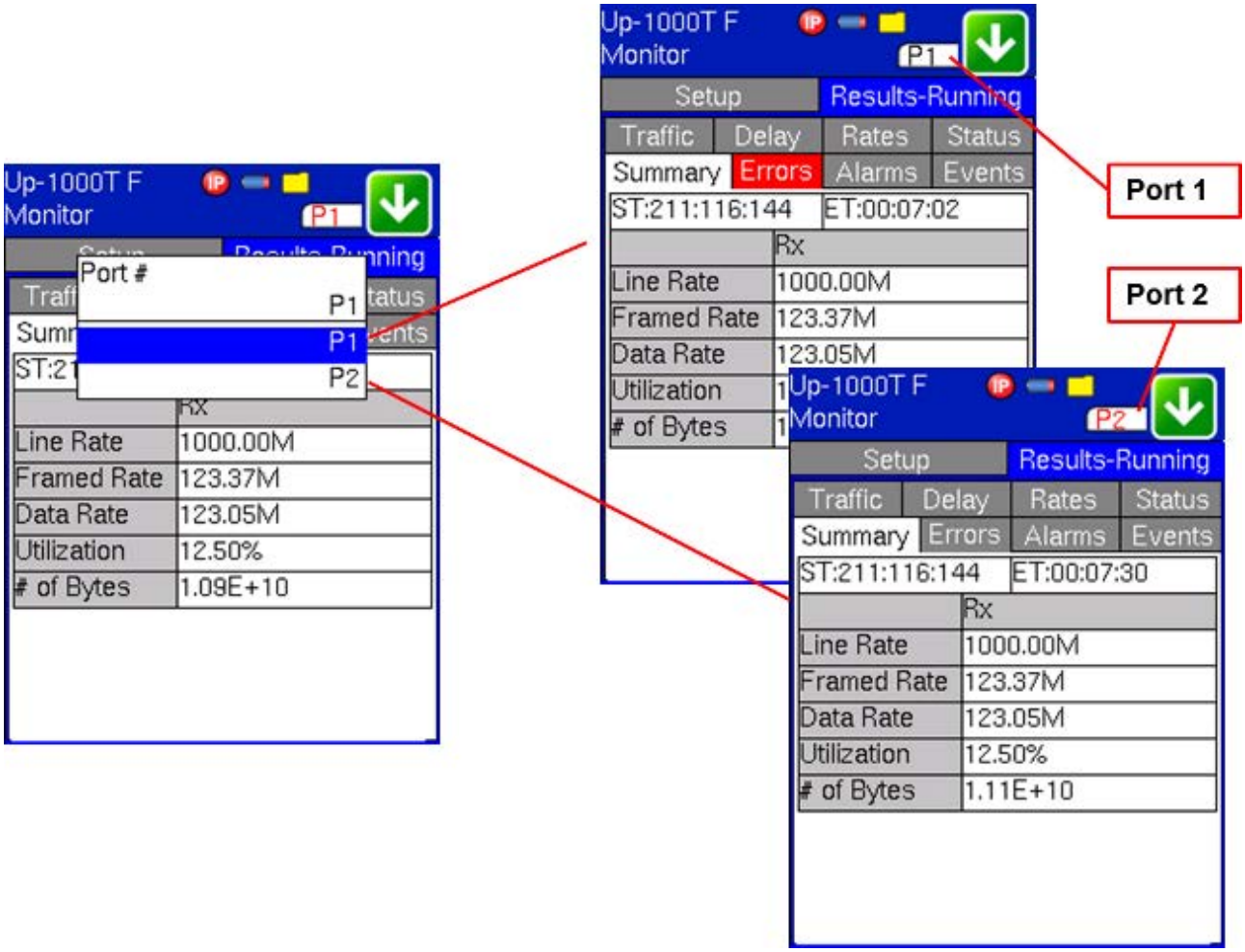
11.2.6 Port Selection

To view Port 1 and Port 2 results, select "P1" and "P2" respectively to switch between ports.

Port Selection - Monitor Mode



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12.0 Loopback

The loopback application in the main menu allows the user to establish a manual loopback on the test set. The loopback function is used when an end-to-end test needs to be performed with one of the test partners in software loopback mode. The loopback function will loop back the incoming traffic to the test set back into the network under test.

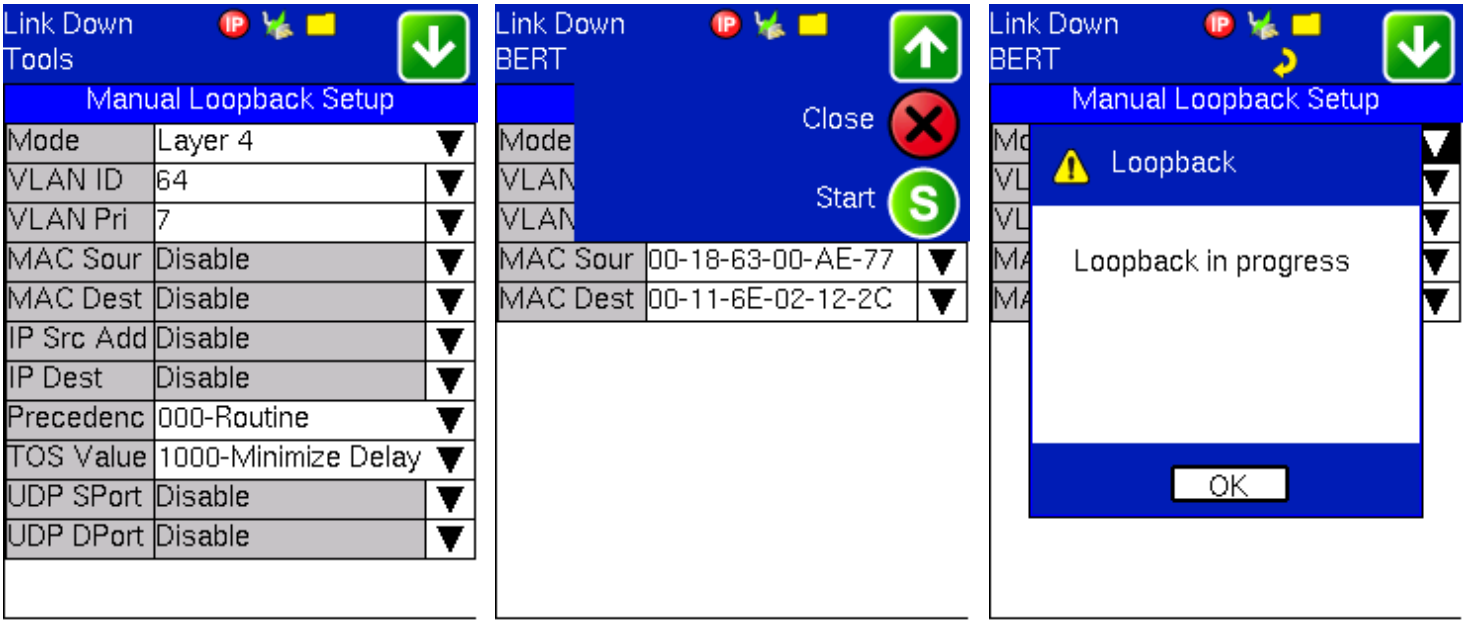
The type of traffic that the loopback function loops back will depend on the type of test layer configured (Layer 1, 2, 3, or 4). Additional criteria can be set to allow only messages with specific criteria to be looped back. To specify loopback parameters, select the desired parameter and choose **Enable** from the drop-down menu. Tap on the box and input a value or select one of the drop-down menu choices:

- **Layer 1**: All incoming traffic to the Rx loopback interface will be sent out unaltered to the Tx loopback interface.
- **Layer 2, 3, & 4**: In a Layer 2 or 3 loopback all incoming test traffic will be looped back.
  - The loopback function will swap the MAC destination and MAC Source addresses (for Layer 2) or MAC and IP destination and source addresses (for Layer 3).
  - All incoming frames with CRC errors will be dropped, similar to what an Ethernet switch does.
  - All broadcast and multicast frames will be dropped including any incoming unicast frames that have the MAC Source address equal to the MAC Destination address.
  - **Loopback Parameters**: The following parameters are available on Layer 2, 3 and 4. For more information on the parameters, please see 7.1.1 Header Settings in the BERT section. It is possible to enable any of these parameters to create a customer loopback filter. For example, if you enable a filter with VLAN 64, Priority 7, only traffic corresponding to these values will be looped back.
    - VLAN ID
    - VLAN Priority
    - MAC Source
    - MAC Destination
    - IP Source Address (Layer 3 & 4 only)
    - IP Destination (Layer 3 & 4 only)

- Precedence (Layer 3 & 4 only)
- TOS Value (Layer 3 & 4 only)
- UDP SPort (Layer 4 only)
- UDP DPort (Layer 4 only)

Press **Start** on the Action Menu to begin loopback.

Layer 4 Loopback **Action Menu** **Loopback Message**



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13.0 V-SAM

- V-SAM Overview
- V-SAM Setup
  - General Settings
  - Services Settings
    - Header
    - Bandwidth
    - Thresholds
  - Control Settings
- V-SAM Results
  - Configuration Test
  - Performance Test

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13.1 V-SAM Overview

V-SAM (VeEX Service Activation Methodology) is an automated Ethernet service activation test feature conforming to the ITU-T Y.1564 standard, created to address and solve the deficiencies of RFC 2544:

• RFC 2544 was limited to test at the maximum throughput line rate for a single service. SAM is able to run multiple services on a single 10/100/1000 or 10G Ethernet line at a bandwidth ranging from 0 to the line rate, allowing for more realistic stream testing.

• The Frame Delay Variation, also known as (packet) jitter was not included in RFC 2544. Jitter is a critical parameter for real time voice and video services. It is now part of the SAM test suite.

• RFC 2544 validates the service parameters like frame loss, throughput and latency, one after the other, while SAM allows testing all the service critical parameters simultaneously. This results in significant time saving compared to RFC 2544.

Comparison of RFC 2544 and Y.1564

	RFC2544	Y.1564
Key Test Objective	Device performance	Network Service verification/activation
Service validation	One service at a time	Multiple services simultaneously
Throughput	Yes	Yes
Latency	Yes	Yes
Frame Loss	Yes	Yes
Burstability	Yes	Yes
Packet Jitter	No	Yes
Multiple Streams	No	Yes
Test Duration	Long (serialized test procedure)	Short (simultaneous test/service)
Test Result	Link performance limit	Related to SLA, fast, simple, Pass/Fail

Test Methodology

The purpose of the SAM test suite is to verify that the service is compliant to its Bandwidth Profile and Service Acceptance Criteria. The test is broken down into two phases:

- **Phase 1: Service Configuration test:** The services running on the same line are tested one by one to verify the correct service profile provisioning.
- **Phase 2: Service Performance test:** The services running on the same line are tested simultaneously over an extended period of time, to verify network robustness.

Test Application

Phase 1: Service Configuration Test

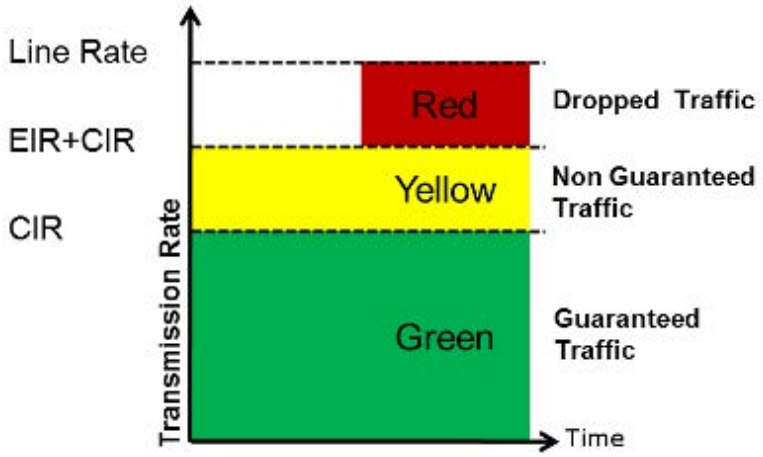
The service configuration test is broken down into three steps. The steps are tested individually for all the services delivered on the same line.

- **Step 1: Committed Information Rate (CIR) Test:** Traffic is transmitted at the CIR for a short period of time and the received traffic is evaluated against the Service Acceptance Criteria (FLR, FTD, FDV) measured simultaneously. The CIR test passes if the measurements on the received traffic stay below the performance objectives.
- **Step 2: Excess Information Rate (EIR) Test:** Traffic is transmitted at the CIR+EIR rate for a short period of time; the EIR test passes if the received traffic rate is between the CIR (minus the margin allowed by the FLR) and CIR+EIR.

- **Step 3: Traffic Policing (Overshoot Test):** The purpose of the Traffic Policing Test is to ensure that when transmitting at a rate higher than the allowed CIR+EIR, the excess traffic will be appropriately blocked to avoid interference with other services. For this test, traffic is transmitted at 25% higher than the CIR+EIR for a short period of time. The test passes if the received traffic rate is at least at the CIR (minus the margin allowed by the FLR) but does not exceed the allowed CIR+EIR.
- At this time the **Committed Burst Size (CBS)** and **Excess Burst Size (EBS)** tests are considered experimental and not an

integral part of the standard.

Service Bandwidth Profile



Phase 2: Service Performance Test

Services running on the same line are tested simultaneously over an extended period of time, to verify network robustness. Service Acceptance Criteria (SAC) including Frame Transfer Delay (FTD), Frame Delay Variation (FDV), Frame Loss Ratio (FLR) and Availability (AVAIL) are verified for each service.

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13.2 V-SAM Setup

13.2.1 General Settings

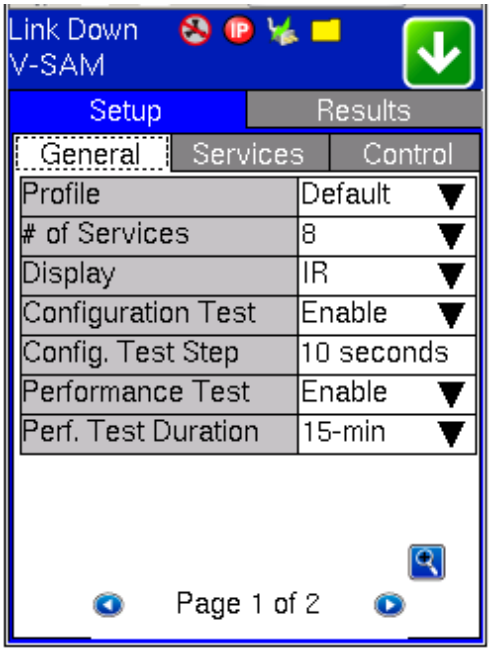
General (Page 1)

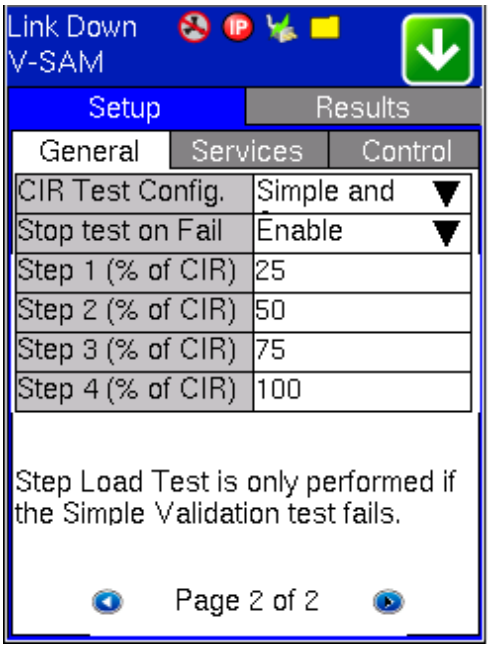
- **Profile:** Default, Save, Save as New.
- **# of Services:** Select the number of services to run. Up to 8 services can be chosen for a 1 GE interface.
- **Display:** IR (Information Rate), ULR (Utilized Line Rate)
- **Configuration Test:** Enable or Disable the configuration test.
- **Configuration Test Step:** Specify min and max duration for the configuration test step.
- **Performance Test:** Enable or Disable the performance test.
- **Perf. Test Duration:** Selections are 15 min, 30 min, 1 hour 2 hours, 24 hours, and user defined. User defined enables the user to specify min and max duration for the performance test.

General (Page 2)

- **CIR Test Config.:** Select Simple Test, Step Load Test, or Simple and Step.
  - **Simple Test:** Starts the tests at the CIR.
  - **Step Load Test:** Starts the test below the CIR and continues in steps until it reaches the CIR.
  - **Simple and Step Load Test:** Step Load Test performs only if the Simple Validation test fails.
- **Step #:** Tap on the corresponding box to enter the percentage of CIR that the test will reach for each step.

V-SAM Setup (Page 1) **V-SAM Setup (Page 2) - Simple and Step Load Test**





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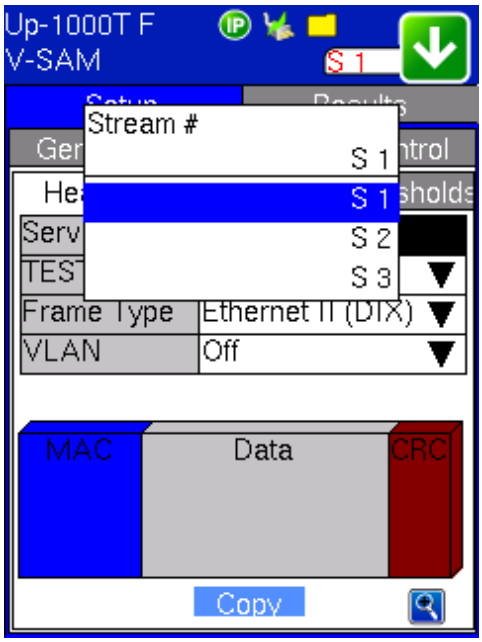
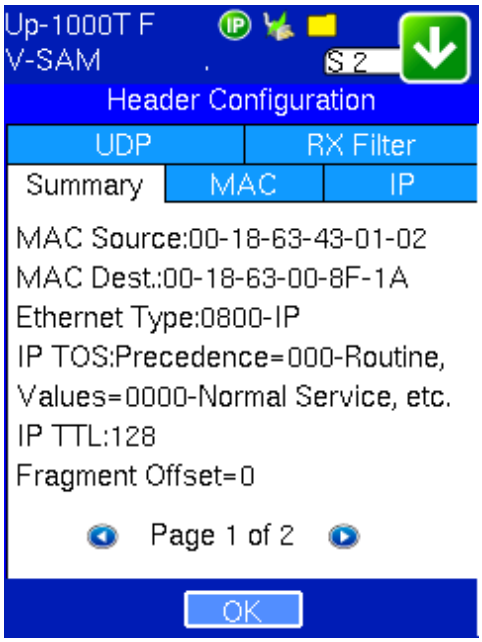
13.2.1 Services - Header Settings

Please see 8.1 RFC 2544 Setup and follow the setup procedure to configure the Header Settings for V-SAM. Tapping the zoom function on the bottom right hand side of the screen displays the Summary, MAC and RX Filter tabs which are also explained in the RFC 2544 Setup section. The user can assign a name to each stream by tapping on the **Service Name** box and entering a name.

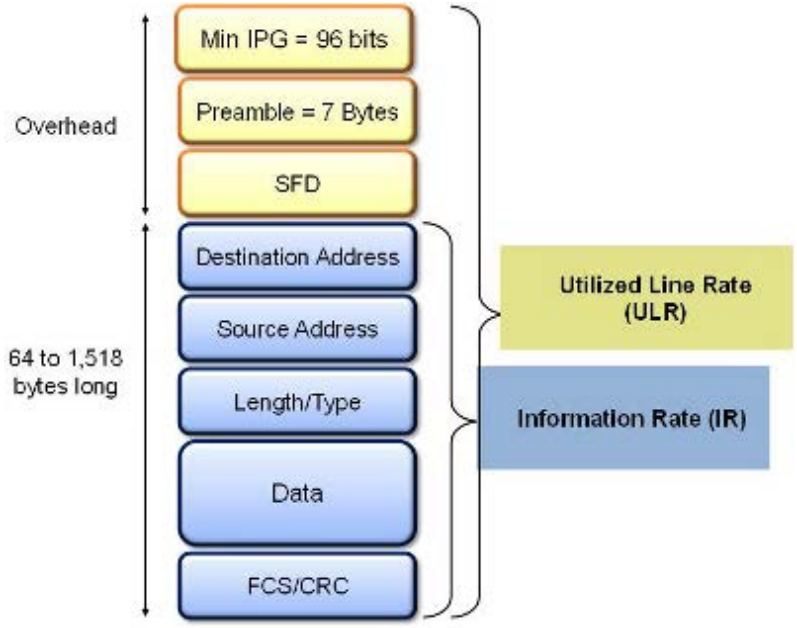
V-SAM Services - Header - Selecting a Stream



V-SAM Header Configuration



V-SAM Services - Header



Selecting a Stream

On the Services tab, tap on the stream number (S #) next to the Action Menu icon to select a service to configure.

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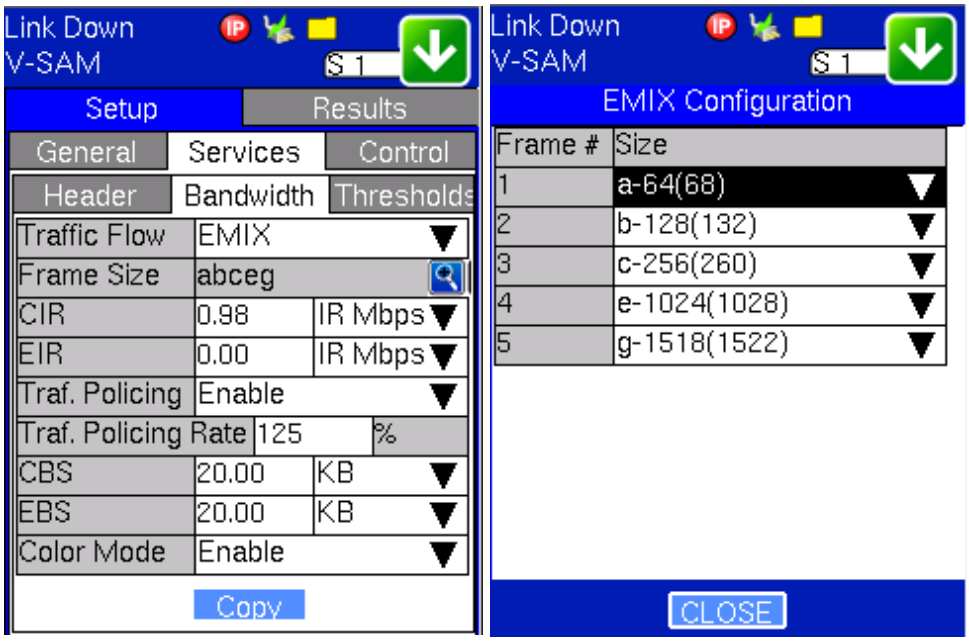
13.2.2 Services - Bandwidth Profile

The Bandwidth Profile specifies how much traffic the customer is authorized to transmit and how the frames are prioritized within the network. Under the Bandwidth tab, the user specifies the following bandwidth criteria:

- **Traffic Flow:** Defines the Frame Size Type - Fixed or EMIX (Ethernet Mix)
- **Frame Size:**
  - **For Fixed Traffic Flow:** Input a fixed frame size within the range of 64-10000 bytes by tapping the value box.
  - **For EMIX:** The default value is abceg. Tap the zoom (magnifying glass) icon to define other values. Select the values from the drop down lists on the next screen.
    Note: *Any EMIX configuration of 5 frames is allowed.*

V-SAM Services - Bandwidth **V-SAM Services - EMIX Configuration**



- **CIR:** Committed Information Rate. This is the guaranteed maximum rate at which the customer can send frames that are assured to be forwarded through the network without being dropped. Tap on the box to enter a rate and choose between **IR Mbps** or **ULR Mbps**. Allowed values range from 0.01Mbps to the line bandwidth.
  - **Information Rate (IR):** Measures the average Ethernet frame rate starting at the MAC address field and ending at the CRC.
  - **Utilized Line Rate (ULR):** Measures the average Ethernet frame rate starting with the overhead and ending at the CRC.

- **Excess Information Rate (EIR):** Maximum rate above the CIR at which the customer can send frames that will be forwarded on a best effort basis, but may be dropped in the event of congestion within the network. The combined CIR and EIR must not exceed the line bandwidth. Traffic beyond CIR + EIR will be dropped when it enters the carrier's network. Tap on the box to enter a rate. EIR is expressed in terms **IR Mbps** or **ULR Mbps**. Select a term to express EIR or select **Disable** to disable the test.

- **Traf. Policing:** Enable or Disable the traffic policing test. For this test, traffic is transmitted at 25% higher than the CIR+EIR. The Policing test fails if the higher traffic rate is allowed through the network.

- **Color Mode:** Enable, Disable. When Color Mode is enabled, the Drop Eligible parameter in the VLAN header configuration screen becomes grayed out and cannot be configured. If no VLAN is configured for the service traffic, the Color Mode parameter is ignored.

- **CBS** and **EBS**: Committed Burst Size (CBS) and Excess Burst Size (EBS).
  - CBS can be enabled without enabling EBS
  - If EBS is enabled, then CBS is automatically enabled too
  - Values between 4 KBytes and 100 KBytes can be input for both CBS and EBS

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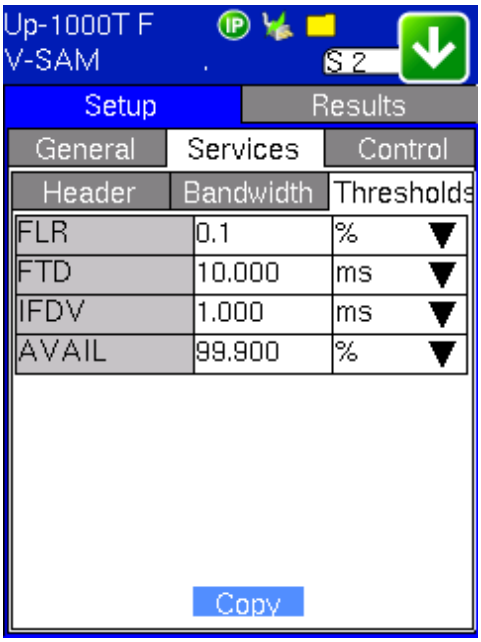
13.2.3 Services - Thresholds Settings

The user establishes Pass/Fail test criteria for the following Service Acceptance Criteria. Values define the minimum requirements to ensure that the service meets the Service Level Agreement (SLA):

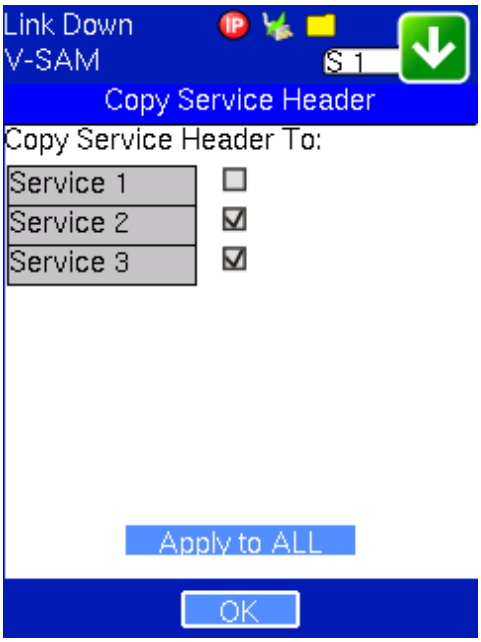
- **FLR:** Ratio of lost frames to the total transmitted frames.
- **FTD:** Measures the transfer time that the frames can take to travel from source to destination. Values are measured in us, ms, or sec. Input a value within the digital range of .001-999 and 1 us-999sec. The user can also choose to **Disable** the FTD threshold evaluation. FTD will be measured regardless, but the value will not contribute toward passing or failing the service.
- **IFDV:** Measures the frame jitter.
- **AVAIL:** The service becomes unavailable if more than 50% of the frames are errored or missing in a one second interval. Availability is only guaranteed for traffic conforming to the CIR. Enter a percentage from 0-100. The user can also choose to **Disable** the AVAIL threshold evaluation. AVAIL will be measured regardless, but the value will not contribute toward

passing or failing the service.

V-SAM Services - Thresholds



Copying Frame Configurations Between Services



Copying Services

Tap on the **Copy** button on the bottom of any of the **Services** tabs (**Header**, **Bandwidth**, **Threshold**) to copy frame parameters specific to that tab to other services. For example, pressing Copy on the Header tab will only transfer header parameters to other services.

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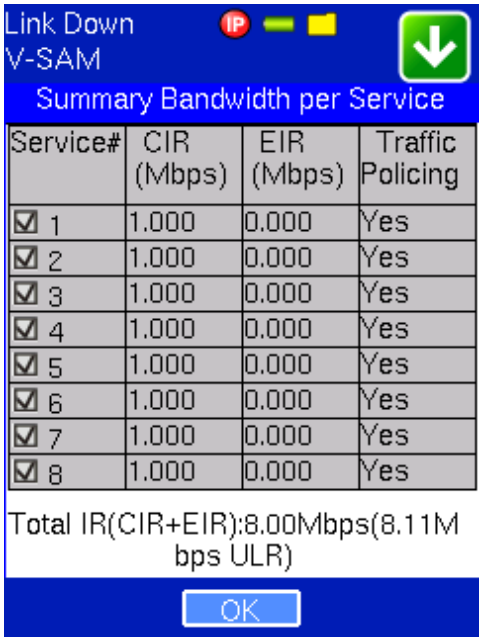
13.2.4 Services - Summary

V-SAM Services Summary



V-SAM Services Summary

Once setup parameters are completed, tapping the zoom function at the bottom right hand side of the screen displays a summary of all service settings. A check next to the Service number indicates that the test for the corresponding service is set to run. Tap on the box to remove the check and cancel the test for that service.

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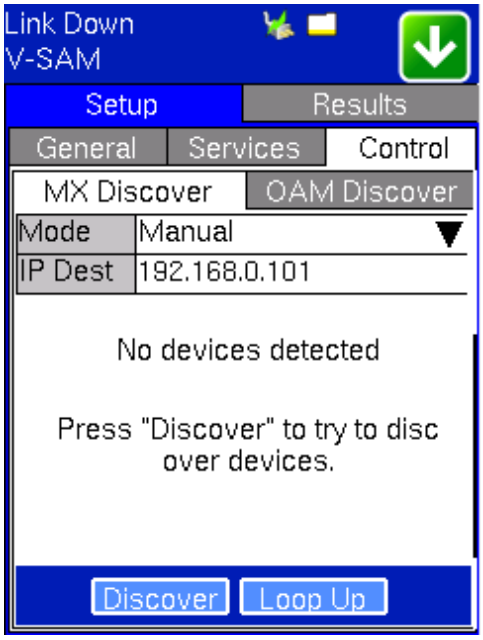
13.2.5 Control Settings

Please see 7.1.4 Control Settings for information on setting up a remote connection with another unit. Note that Manual Mode is the only available option for V-SAM Control settings.

V-SAM Control Setup



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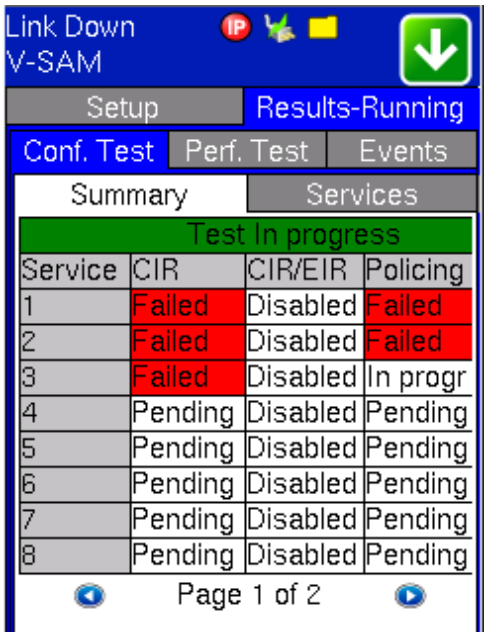
13.3 Results

13.3.1 Configuration Test

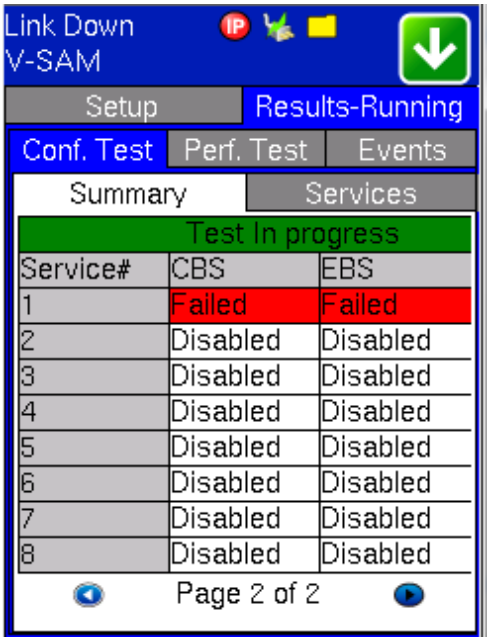
***Note**: To run the test, make sure that traffic is being looped back at the far-end of the network under test.*

The **Summary** tab displays the status of each service and test as **Pass**, **Failed**, **Pending**, or **Disabled**. Tapping on **Services** displays live values for FLR, FTD, and FDV as the test is running. If any measured values do not meet the service test parameters set in the Bandwidth and Threshold tabs, the test fails. The zoom function on the bottom right side of the screen displays detailed results for each stream.

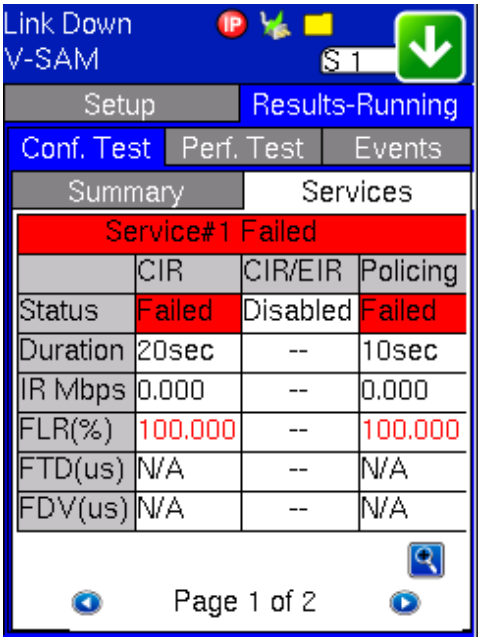
Conf. Test - Summary Tab Page 1



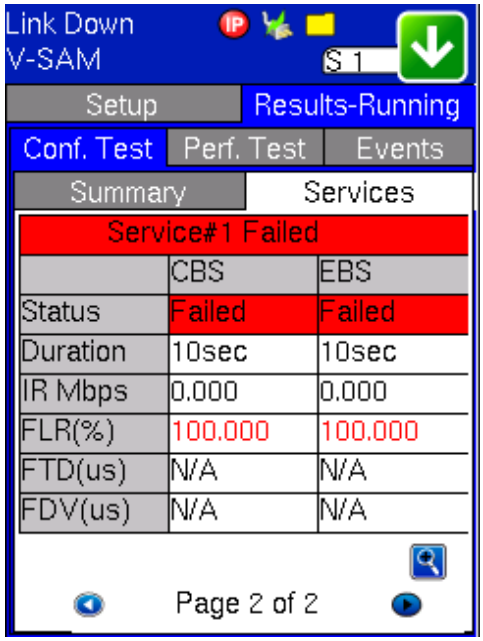
Conf. Test - Summary Tab Page 2



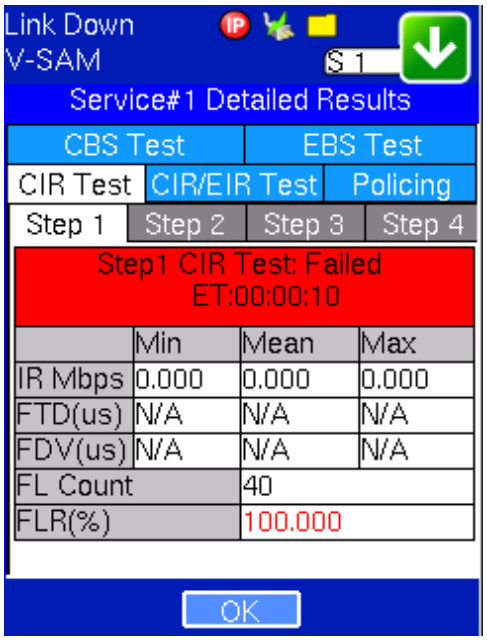
Conf. Test - Services Tab

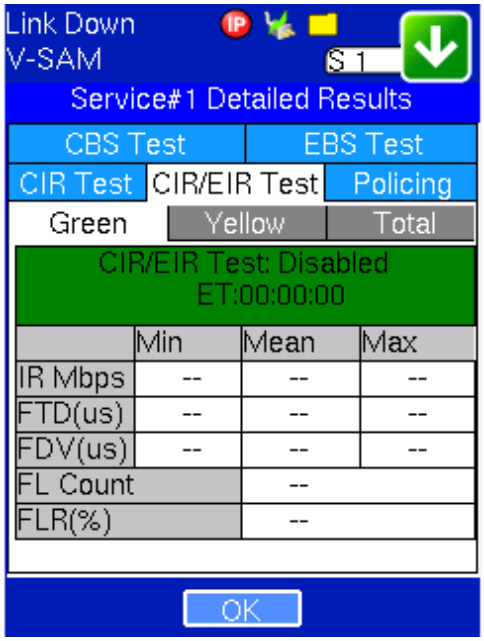


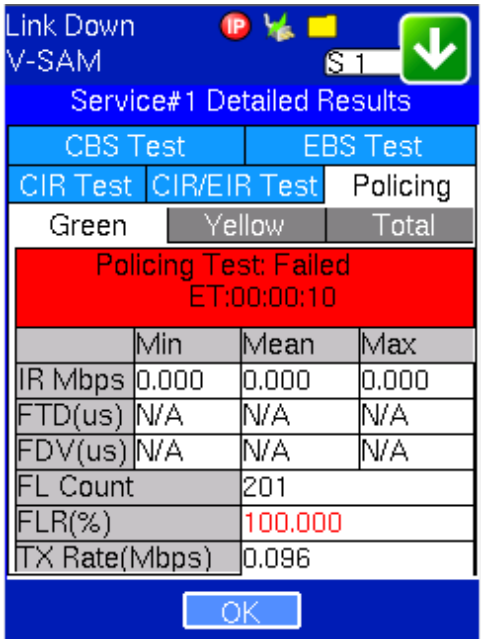
Conf. Test - Services Tab Page 2



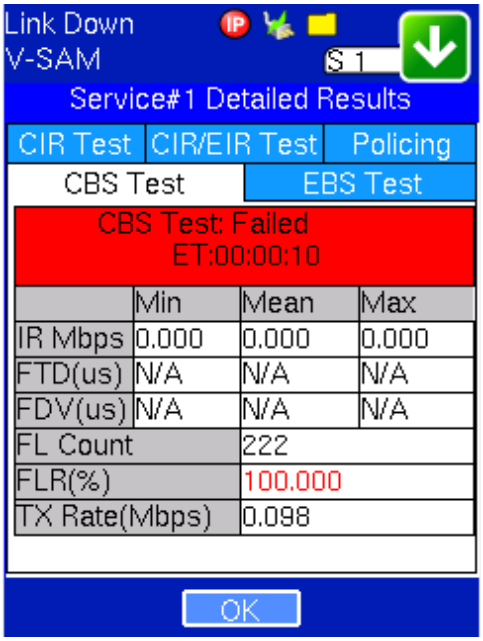
S1 Detailed Results - CIR Test **S1 Detailed Results - CIR/EIR Test** **S1 Detailed Results - Policing Test**



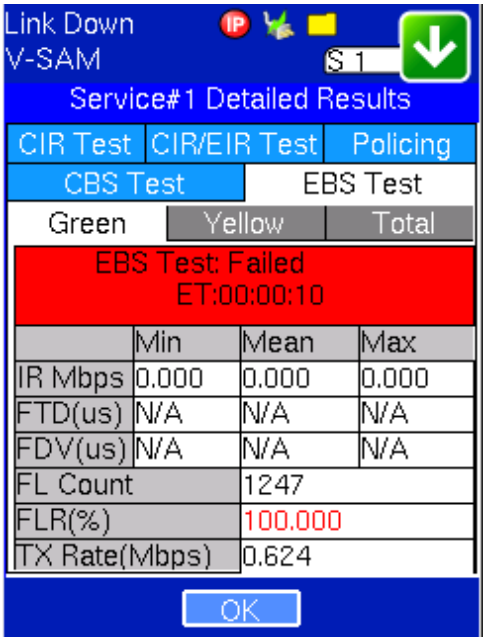




S1 Detailed Results - CBS Test



S1 Detailed Results - EBS Test



Viewing Test Results on Different Streams

On the Services tab of **Conf. Test** and **Perf. Test**, tap on the service number (S #) next to the Action Menu icon to view the test results for a specific stream.

- **CIR test:** The test passes if all measured values are below the thresholds configured. If a threshold is disabled, it will not be evaluated towards pass/fail criteria.
- **CIR/EIR test:** The test passes if the received IR value is between the CIR (minus the margin allowed by the FLR) and CIR+EIR.
- **Policing test:** The test passes if the received traffic rate is at least at the CIR (minus the margin allowed by the FLR) but does not exceed the allowed CIR+EIR.

- **CBS Test:** The test passes if the frame loss rate stays below the configured FLR.
- **EBS Test:** The test passes if the frame loss rate stays below the configured FLR.

CBS, EBS, CIR, **CIR/EIR Test**, and **Policing** tabs display min, mean, and max values for **IR Mbps**, **FTD**, **FDV**, **FL Count**, and **FLR (%)**. If Step Load was selected for the CIR Test, these values will be displayed for each step.

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13.3.2 Performance Test

The Summary tab displays the status of each service and test as Pass, Failed, or Pending. Tapping on Services displays live values for the following parameters as the test is running:

Page 1

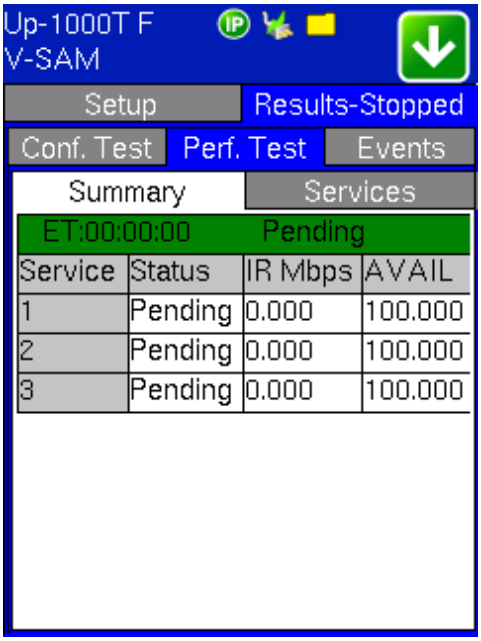
- **IR Mbps:** Information Rate. Measures the average Ethernet frame rate starting at the MAC address field and ending at the CRC.
- **FTD:** Measures the transfer time that the frames can take to travel from source to destination.
- **FDV:** Measures the frame jitter.
- **FL Count:** Counts the number of lost frames.
- **FLR:** Ratio of lost frames to the total transmitted frames.
- **AVAIL:** The service becomes unavailable if more than 50% of the frames are errored or missing in a one second interval. Availability is only guaranteed for traffic conforming to the CIR.

Page 2

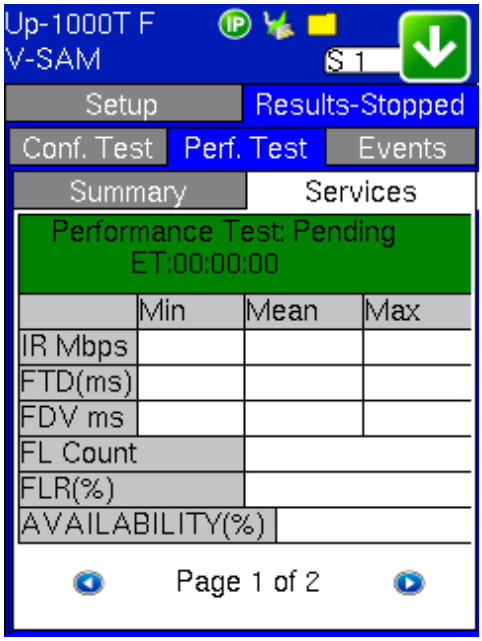
- **Severely Errored Sec (SES):** Occurs for a block of frames over a one-second interval, when more than 50% of the frames are errored or missing.
- **Unavailable Sec:** An interval of time that begins at the start of 10 consecutive SES occurrences. The ethernet network is in unavailable state during this time span.
- **Total RX Frames:** Total number of frames received.
- Number of **Out of Sequence Counts**.
- **Errored Frame Count:** Number of frames with CRC or IP Checksum errors.

Measured values that do not meet the service test parameters set in the Bandwidth and Threshold tabs cause the test to fail.

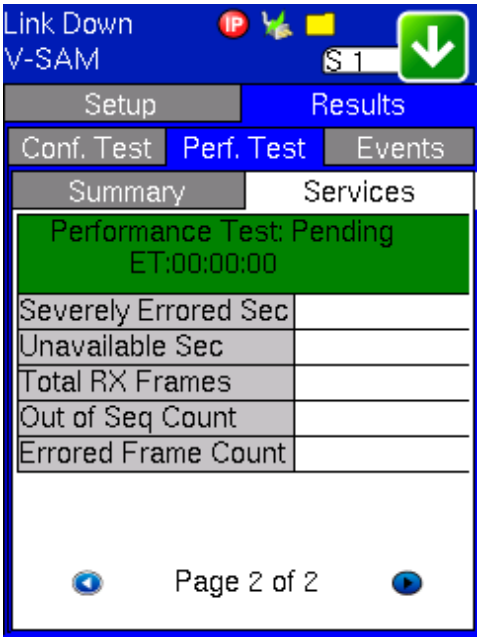
Perf. Test - Summary



Perf. Test - Services (Page 1)



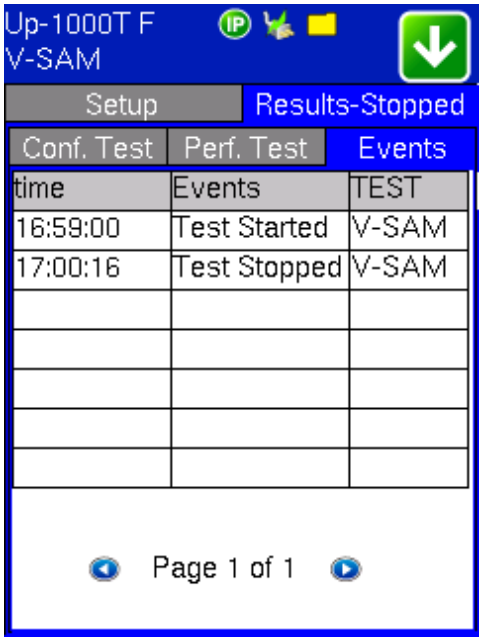
Perf. Test - Services (Page 2)



Events

A time stamped record or log of test types and test statuses (start/stop).

Events



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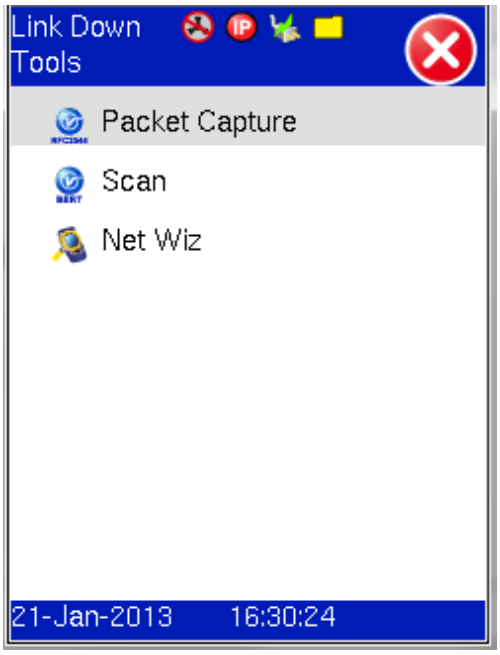
14.0 Additional Tests

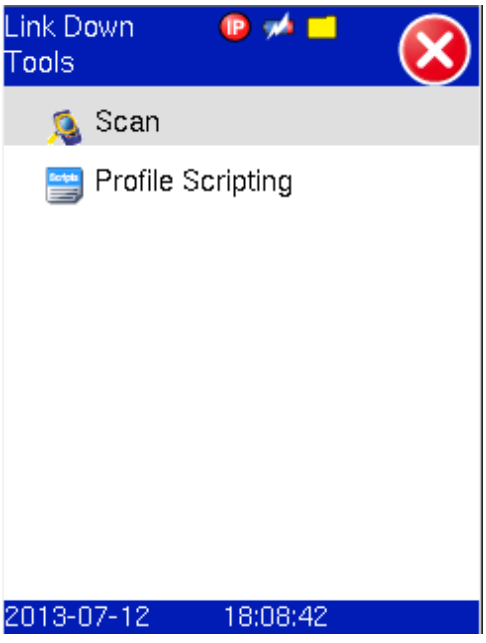
Additional Tests home menu offers the following tools:

- **Packet Capture**
- **Scan**
- **Net Wiz**
- **Profile Scripting (MX100e+ only)**

Additional Tests Home Menu



Additional Tests Home - MX100e+



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14.1 Packet Capture

The packet capture function can be used to capture packets from the 10/100/1000Base-T port or Ethernet management port. The packet capture format is compatible with Wireshark and can be viewed on a PC.

Setup

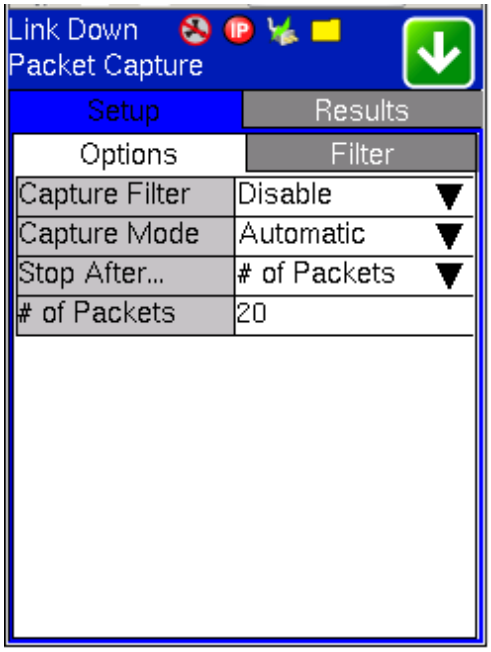
The following **Options** are available for setup:

- **Capture Filter:** Disable/Enable filter.
- **Capture Mode:** Manual or Automatic. Automatic mode stops packet capture after a designated number of packets have been captured or a specified amount of time has passed.
  - **Automatic mode only:**
    - **Stop After...:** Select **# of packets** or **# of seconds**.
    - **# of Packets:** Input the number of packets or seconds for packet capture to stop. Input values must be within the range of 1-65535.

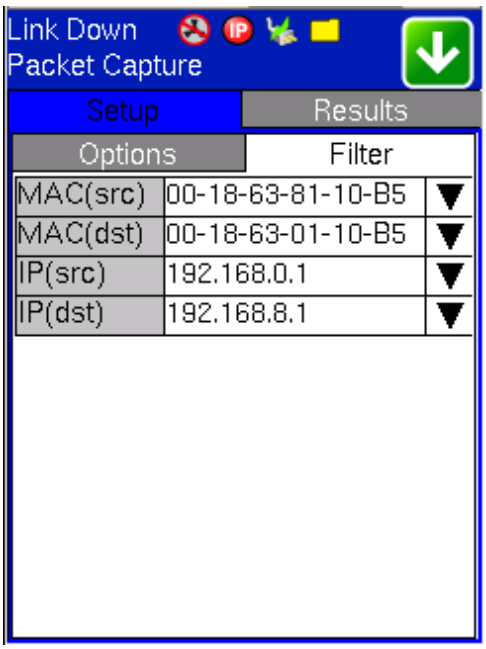
Filter

If Automatic Capture Mode is selected, Packet Capture will only capture packets that meet filter criteria. Use the drop-down menu to enable or disable filters for MAC and IP source/destination. Tap on the box to input source and destination filter addresses.

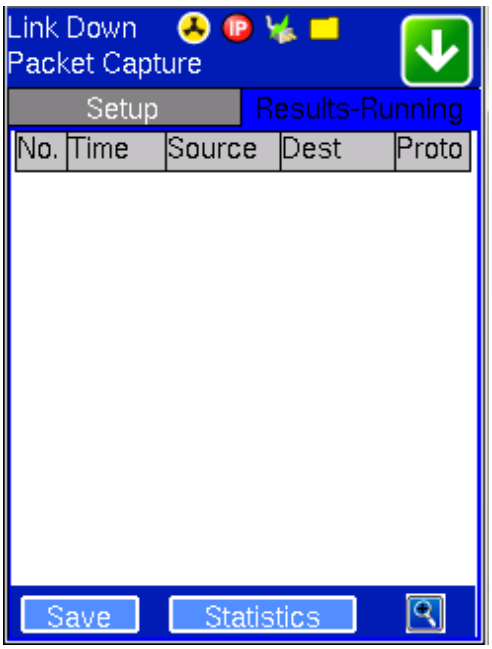
Packet Capture Setup Options



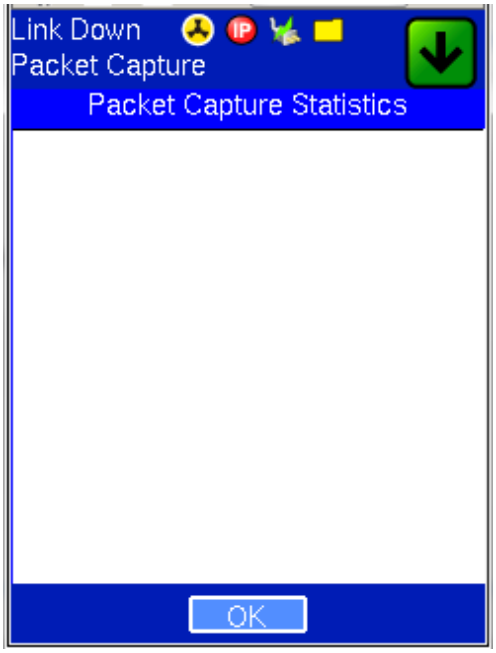
Packet Capture Filter



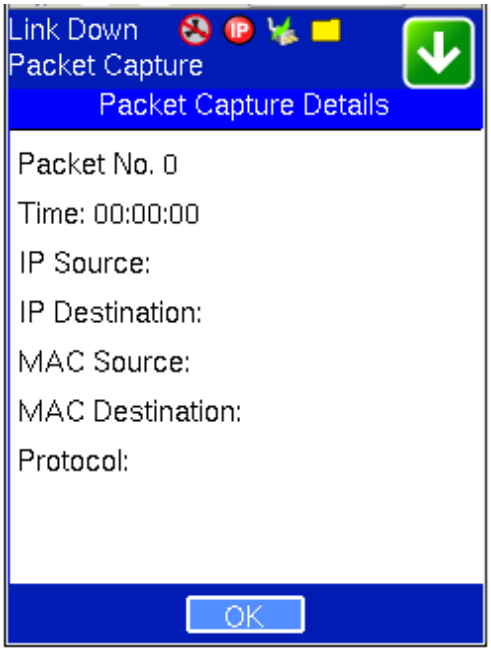
Packet Capture Results



Packet Capture Statistics



Packet Capture Details



Starting/Stopping Packet Capture

Press the Action menu and press **Start** to run packet capture. If set to manual, packet capture will continue to capture packets until the user presses **Stop**.

Results

The Results tab displays packet capture details for each packet in a table format:

- Packet number
- Time of capture
- Source and Destination IP address
- Protocol type (UDP/TCP)

Select a packet and tap on the magnifying glass to see packet capture details for the selected packet. Packet Capture statistics are available for view by pressing the **Statistics** button.

Saving and Viewing Stored Results

Press **Save** to store Packet Capture results. The trace can be retrieved and exported in a .cap format compatible with Wireshark.

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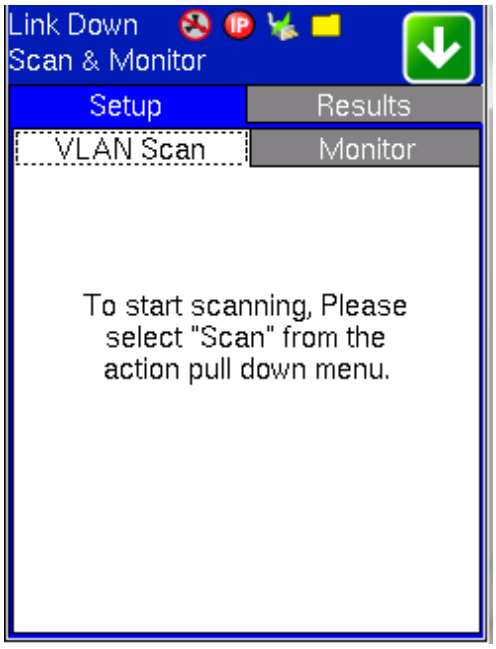
14.2 Scan

Note: Scan is only available in P1 mode.

VLAN Scan scans up to 4096 VLAN IDs for switch configuration and displays VLAN ID bandwidth rates, useful for identifying top bandwidth users based on VLAN ID. Monitor mode monitors up to eight live traffic streams (in terminate mode) and filters them based on VLAN ID configuration, providing key traffic metrics such as frame type, rates, and errors and alarms.

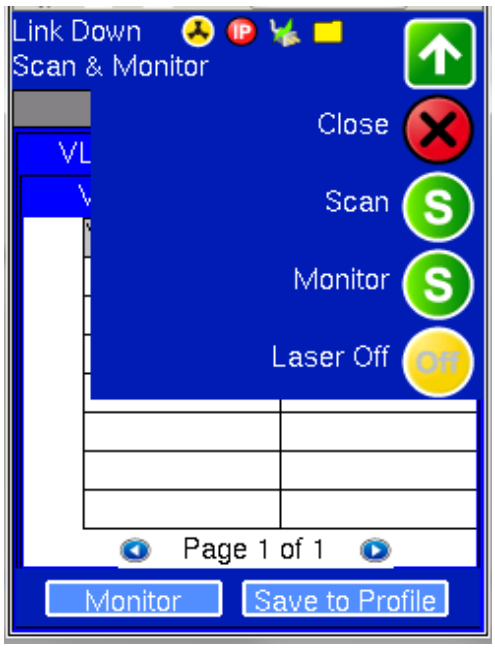
VLAN Scan



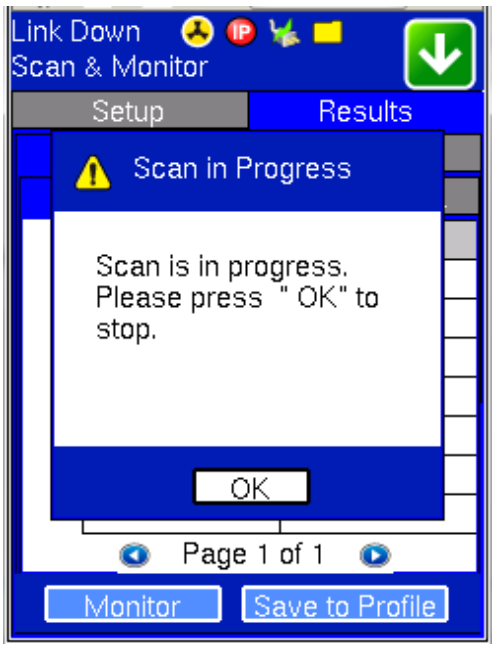
VLAN Scan

- While traffic is being received, press **Scan**. The Results tab displays a list of detected VLAN IDs and the percentage of traffic marked with those IDs. Check up to 8 streams to monitor.
- To store VLAN IDs from the scan, place a check next to the desired VLAN ID(s) and press **Save to Profile**. Use the touch screen keypad to name the profile. The saved profile can now be accessed from the **Setup Monitor** tab.

Scan and Monitor Buttons

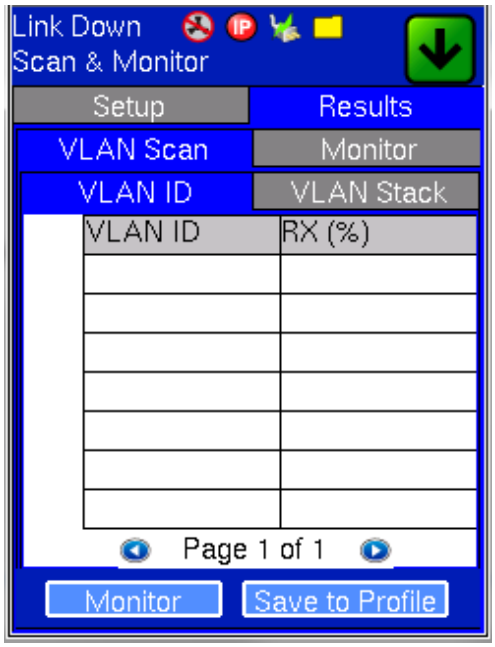


Scan in Progress Message

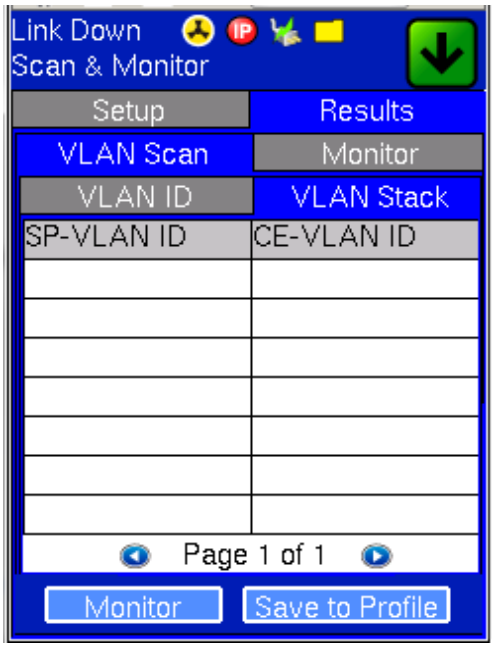


- The VLAN Stack tab displays detected SP and CE VLAN tags (if stack VLAN tags are used).

VLAN ID



VLAN Stack



Monitoring Traffic

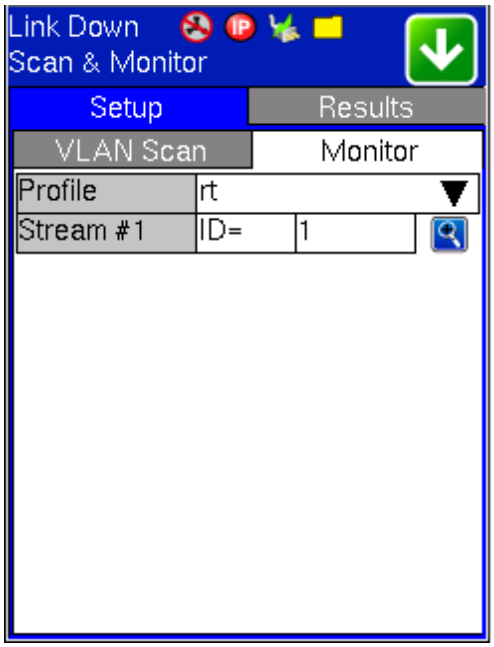
After checking VLAN IDs to monitor (from the **VLAN ID** tab), press **Monitor** (on the screen or from the Action menu) to monitor streaming traffic. To only receive traffic streams meeting specific criteria, go to the Monitor tab to configure filter parameters.

Filtering Traffic (Monitor tab)

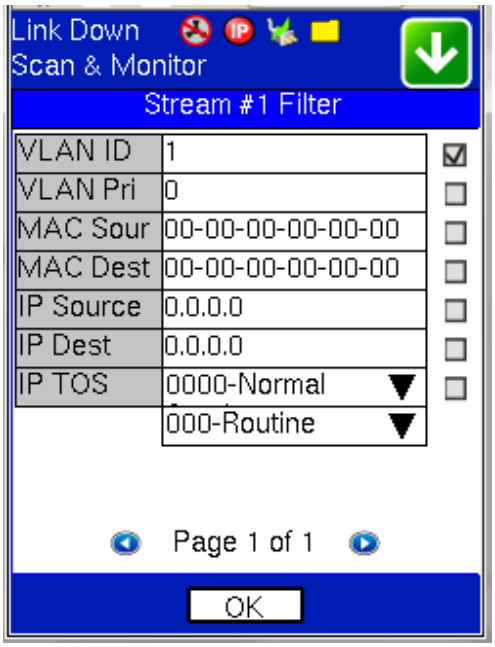
- **Profile:** Select Scan Result, New Profile, or a saved profile.
  - **Scan Result:** Displays stream and VLAN IDs from last scan
  - **New Profile:** Creates a new profile. Input the number of streams (up to 8)
  - **Saved Profile:** Access a saved profile
- Tap on the magnifying glass next to the stream to configure stream filter parameters.
- Tap on a parameter box to configure it. Place a check next to a parameter to only receive traffic that matches this criteria. For a description of each filter parameter, please see, 7.1.1 Header Settings under the BERT section.

- Press **Monitor** from the Action menu to monitor selected streams.

Monitor Setup



Stream Filter Configuration

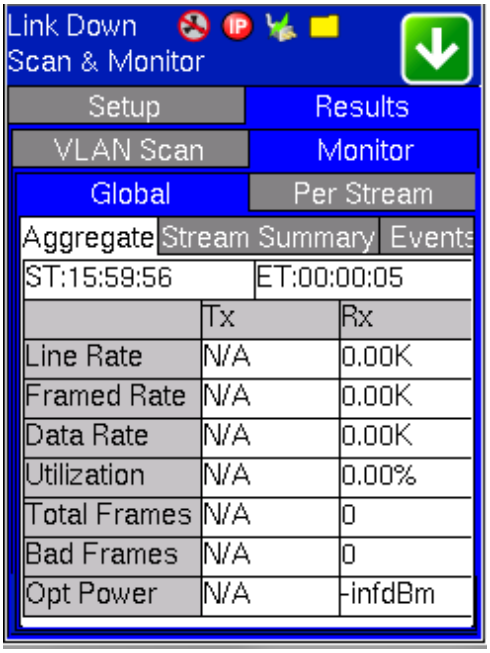


Results

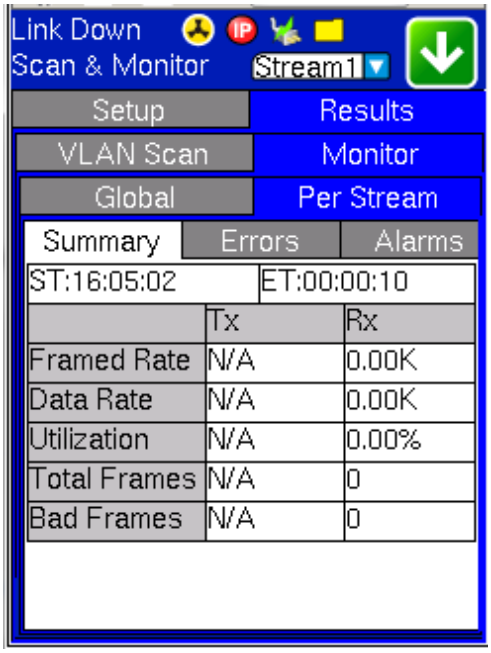
For a description of each measurement from Global and Per Stream Results tabs, please see the Throughput Results section.

To view measurements for other streams, tap on the **Stream #** drop-down menu to select a different stream.

Monitor Results Global



Viewing Results by Stream



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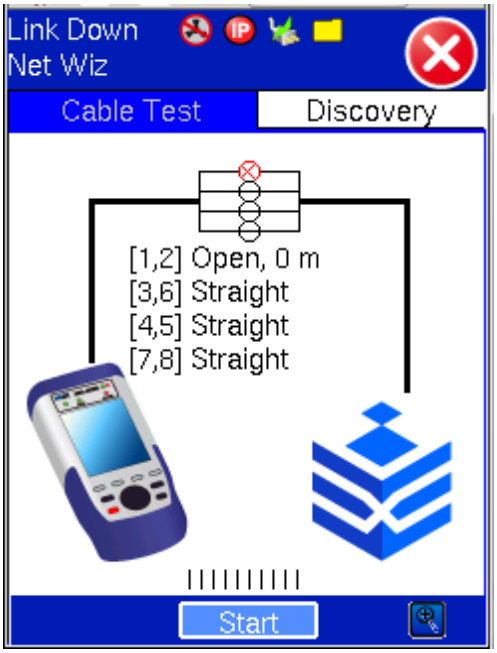
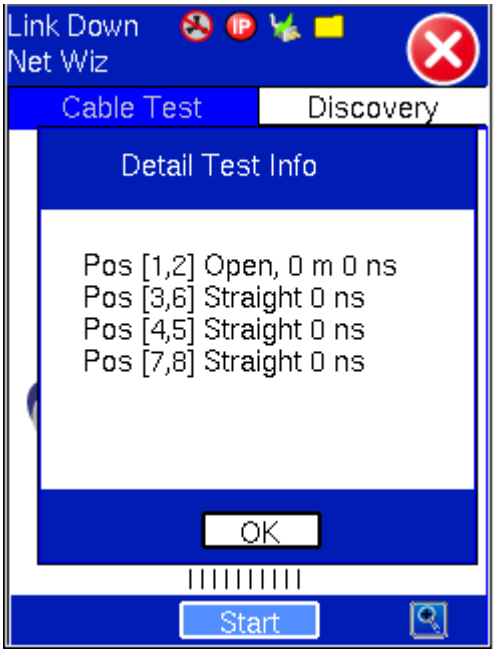
14.3 NetWiz

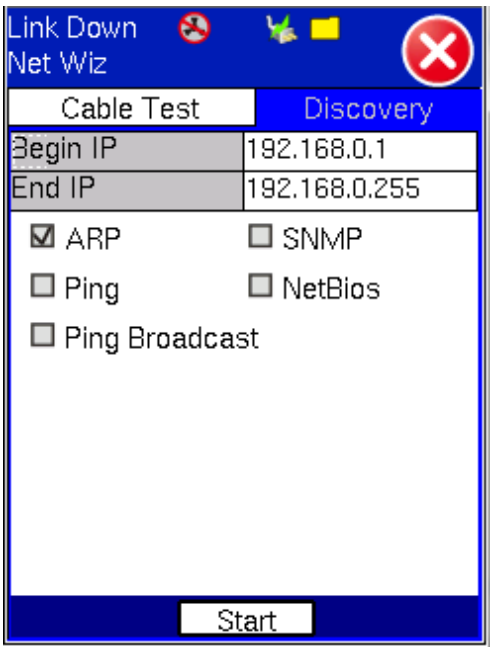
NetWiz function allows the user to test the ethernet cable. Press ‘Start’ to begin the test. The test set will return the connection type (Straight or Cross Over) if connected to an end device. If a fault is detected (Open or Short) the fault will be indicated as well as the distance to the fault.

Tap the magnifying glass icon to get the detailed test info.

NetWiz **Detail Test Info** **Discovery Test**







Discovery
Note: *Before proceeding with the discovery function, please go to IP Tool to establish a connection.*

Check the desired parameters and press 'Start.'

The Discovery summary provides total transmitted and received frames, received frame in error, speed and duplex mode advertised, the number of devices and networks found.

The Devices tab provides a summary of the total devices found and the number of devices are routers, servers or hosts.

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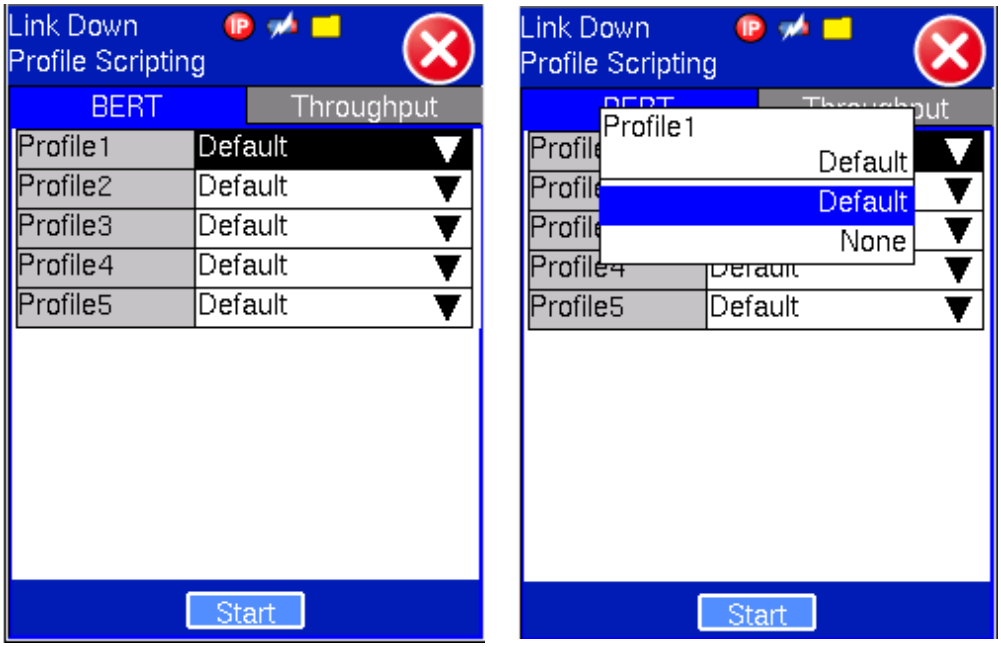
14.4 Profile Scripting (MX100e+ only)

Users can select upto five profiles to create a profile script for BERT and Throughput testing.

1. Tap the Profile Scripting tab to enter the menu.

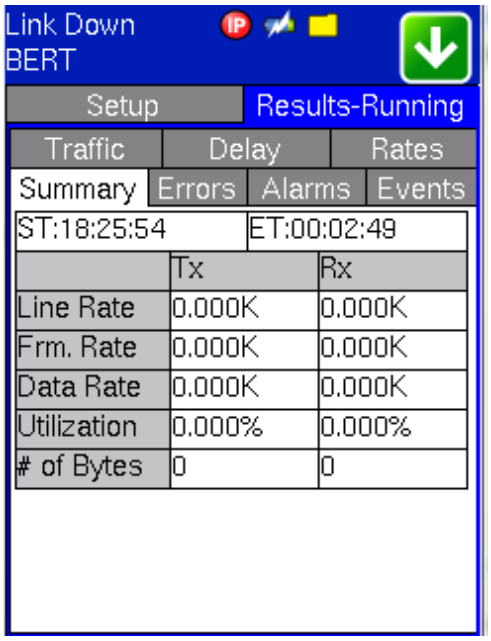
2. Select different Profiles to create the script order.

Profile Scripting Home **Select Profile**



3. Tap Start to start the test. The screen will show the respective test's results screen.

Test Results Summary



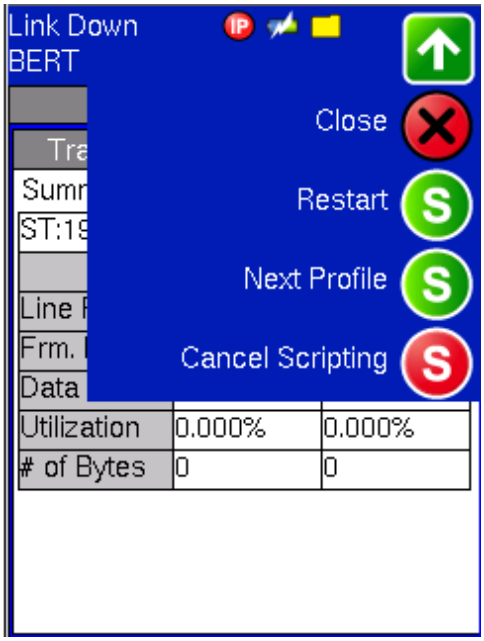
4. Open the Action Menu by tapping the arrow icon in the top right hand corner. The actions available are:

- **Close:** Stop the test
- **Restart:** Restart the test
- **Next Profile:** Move to the next profile in the script for testing. This button only appears after the completion of each profile test.
- **Cancel Scripting:** Stops the scripting procedure, exits the menu and goes back to the Profile Scripting menu.

At the end of the 5th profile the following options become active:

- **Restart:** Restart the scripting for the same 5 profiles selected
- **Exit Scripting:** Exit the scripting

Test Results Action Menu



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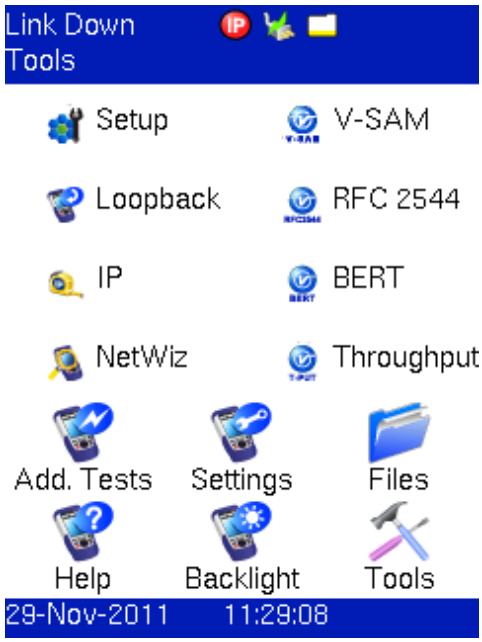
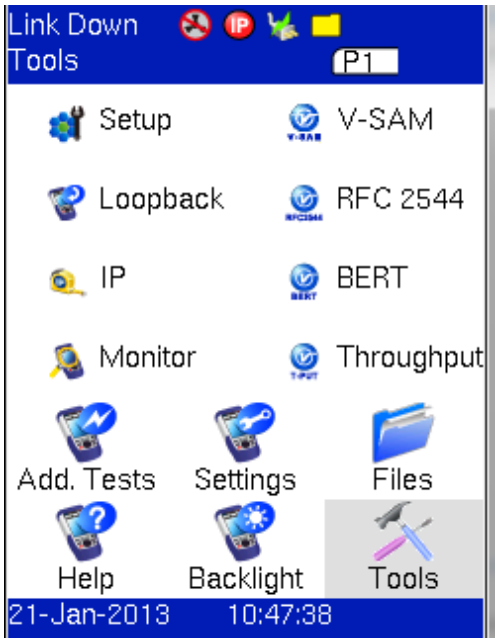
15.0 Common Functions

MX100e+ Home Menu



MX120e+ Home Menu



The following functions are common to all V100+ test sets. Please refer to the **V100+ Common Functions Manual** for these sections. The sections are renumbered in the **V100+ Common Functions Manual** as follows:

- **14.1 (5.1) IP: Web/FTP, ARPWiz, VoIP, Ping, Trace Route**
- **14.2 (5.2) Net Wiz**
- **14.3 (6.0) Settings**
- **14.4 (7.0) Files**
- **14.5 (14.0) Help**
- **14.6 (9.0) Backlight**
- **14.7 (5.0) Tools**

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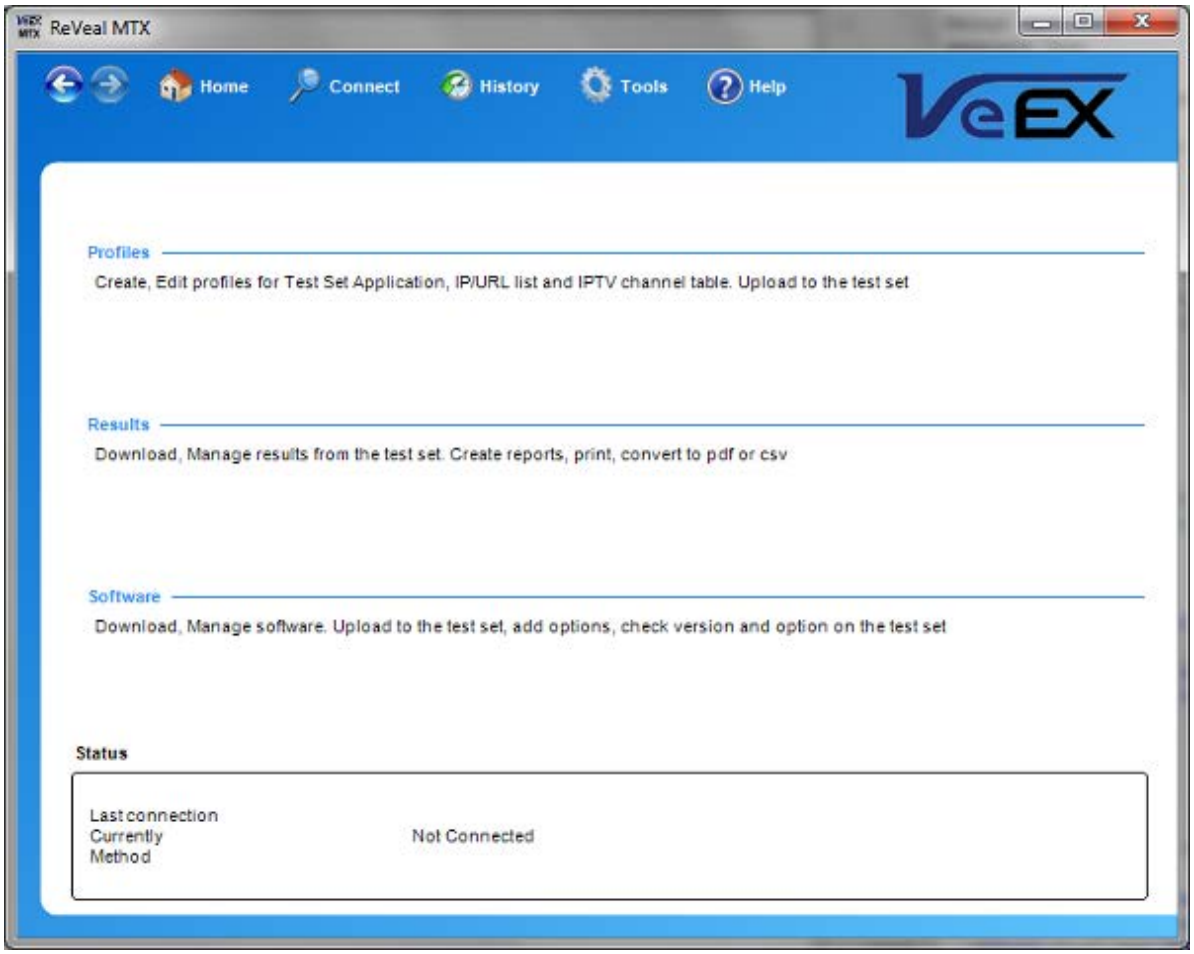
16.0 ReVeal MTX Software

Please install the ReVeal MTX software (supplied with the instrument) onto your PC. The ReVeal software offers the following functionalities:

- **Profiles:** Create, Edit and Manage Test Profiles
- **Results:** Download and Manage test results, generate Test Reports
- **Software:** Download software, upgrade test set, add options, and check instrument configuration
- **Tools:** Remote Control the instrument (optional)

ReVeal MTX - Home Menu



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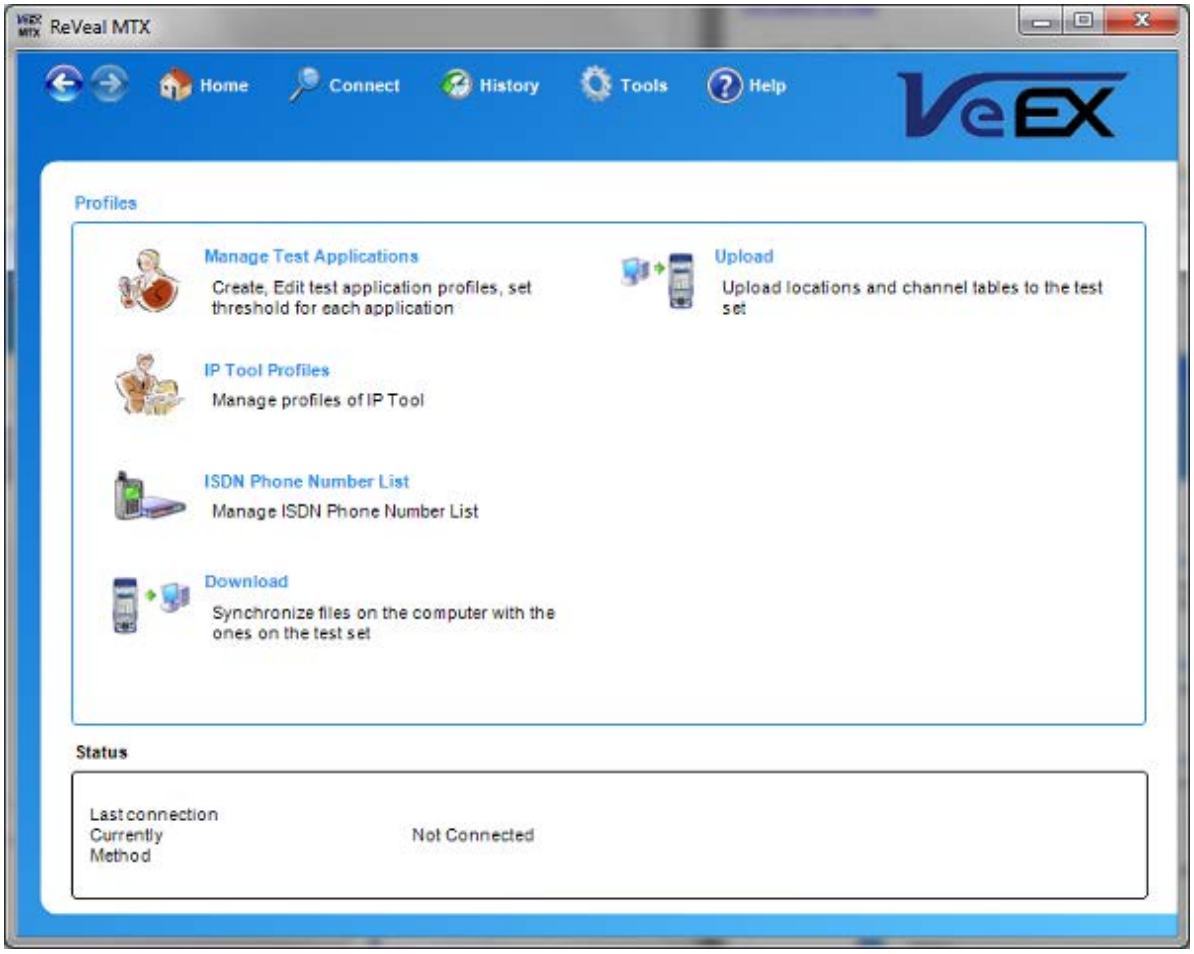
16.1 Profiles

Profiles menu allows you to:

- Manage Test Applications: Create and edit applications including measurement thresholds
- Create new or edit existing IPTV channel tables
- IP/URL List Management: Create new or edit existing IP and URL addresses
- Download files from the test set to the computer
- Upload channel tables and profiles to the test set

ReVeal MTX - Profiles



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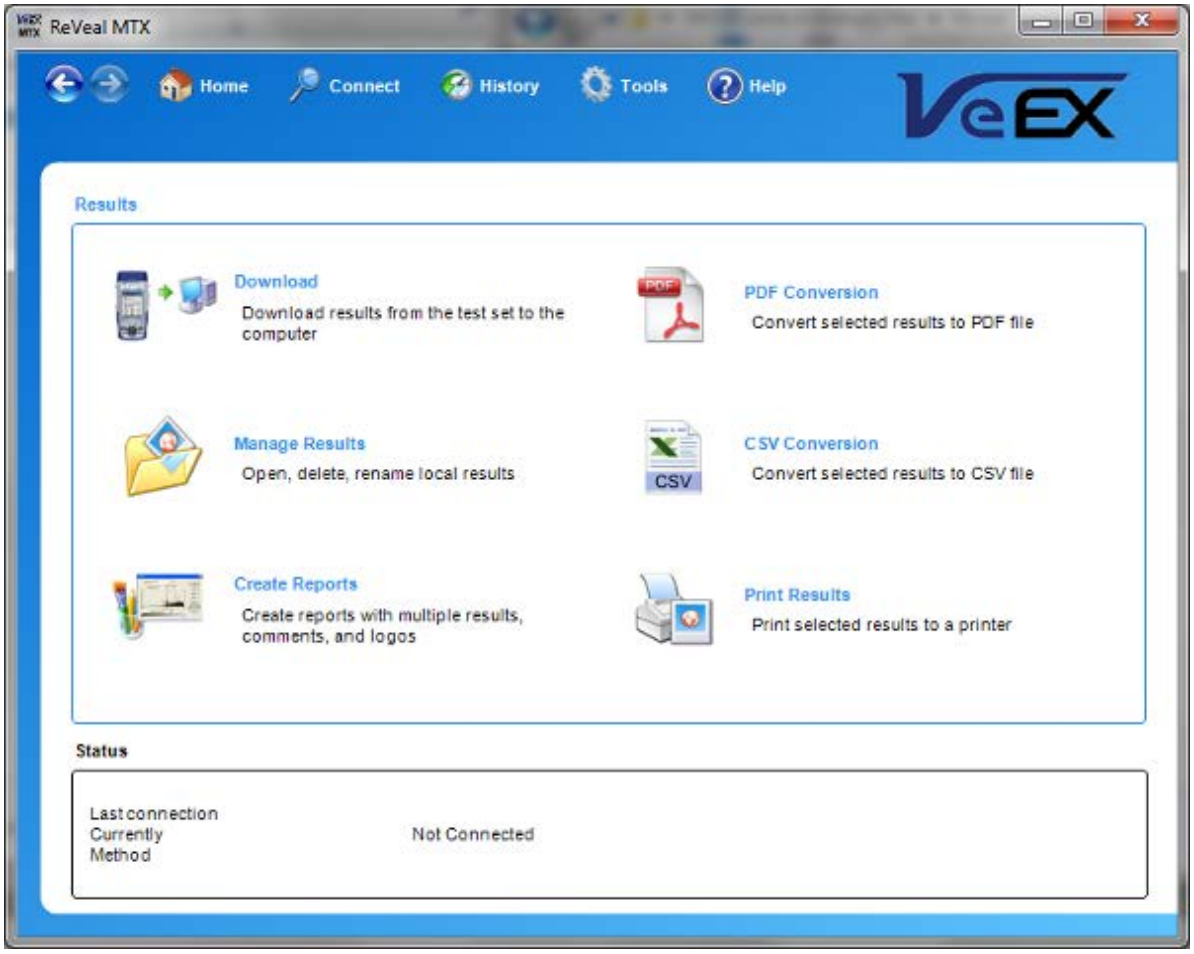
16.2 Results

Results menu allows you to:

- Download Results
- Manage Results
- Create Reports
- Convert Results to PDF format
- Convert Results to CSV (Comma Separated Value) format
- Print Results to a selected printer

ReVeal MTX - Results Menu



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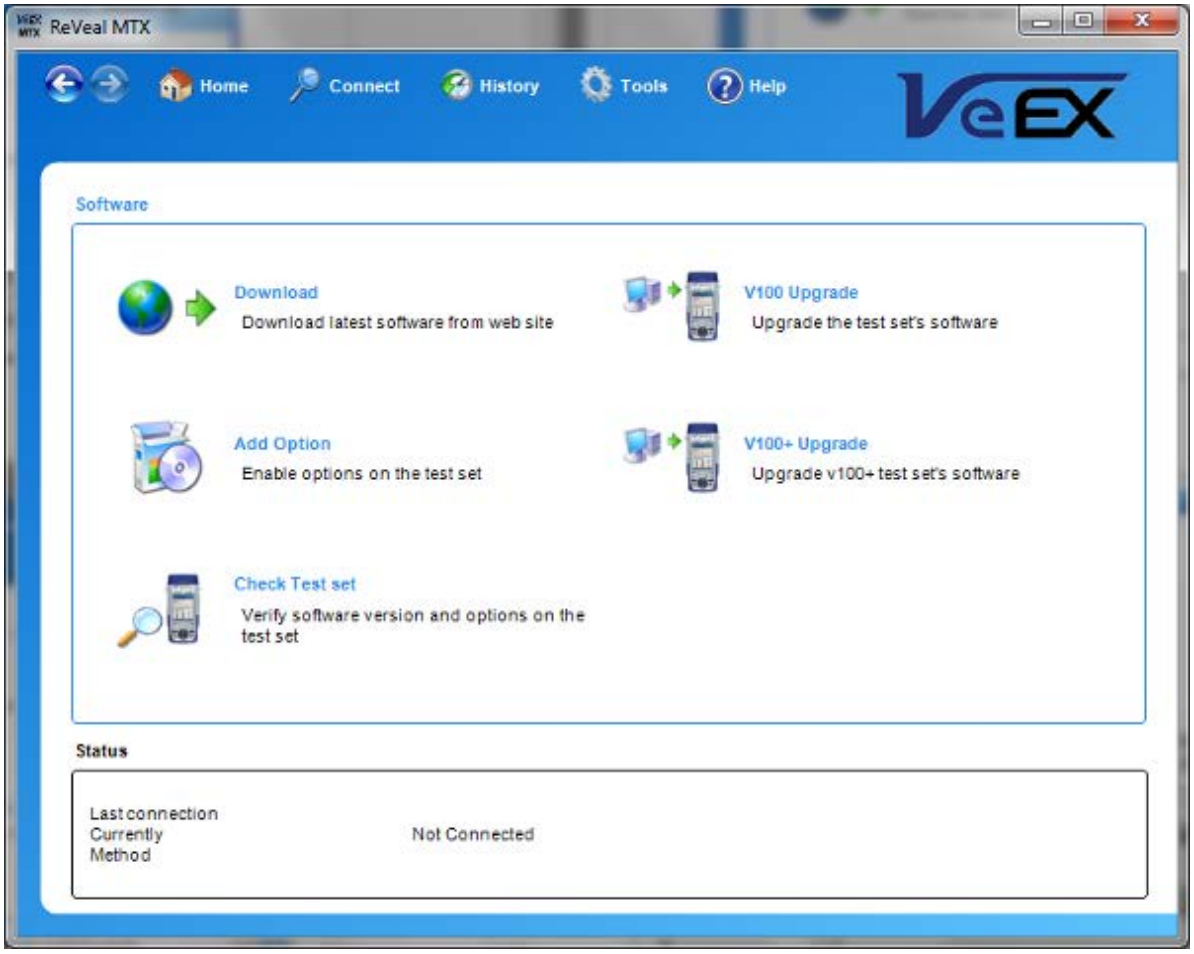
16.3 Software

The **Software** menu allows you to:

- Download software from the VeEX website to upgrade the test set
- Enable or Disable software options
- Check test set configuration
- Upgrade test set software

ReVeal MTX - Software Menu



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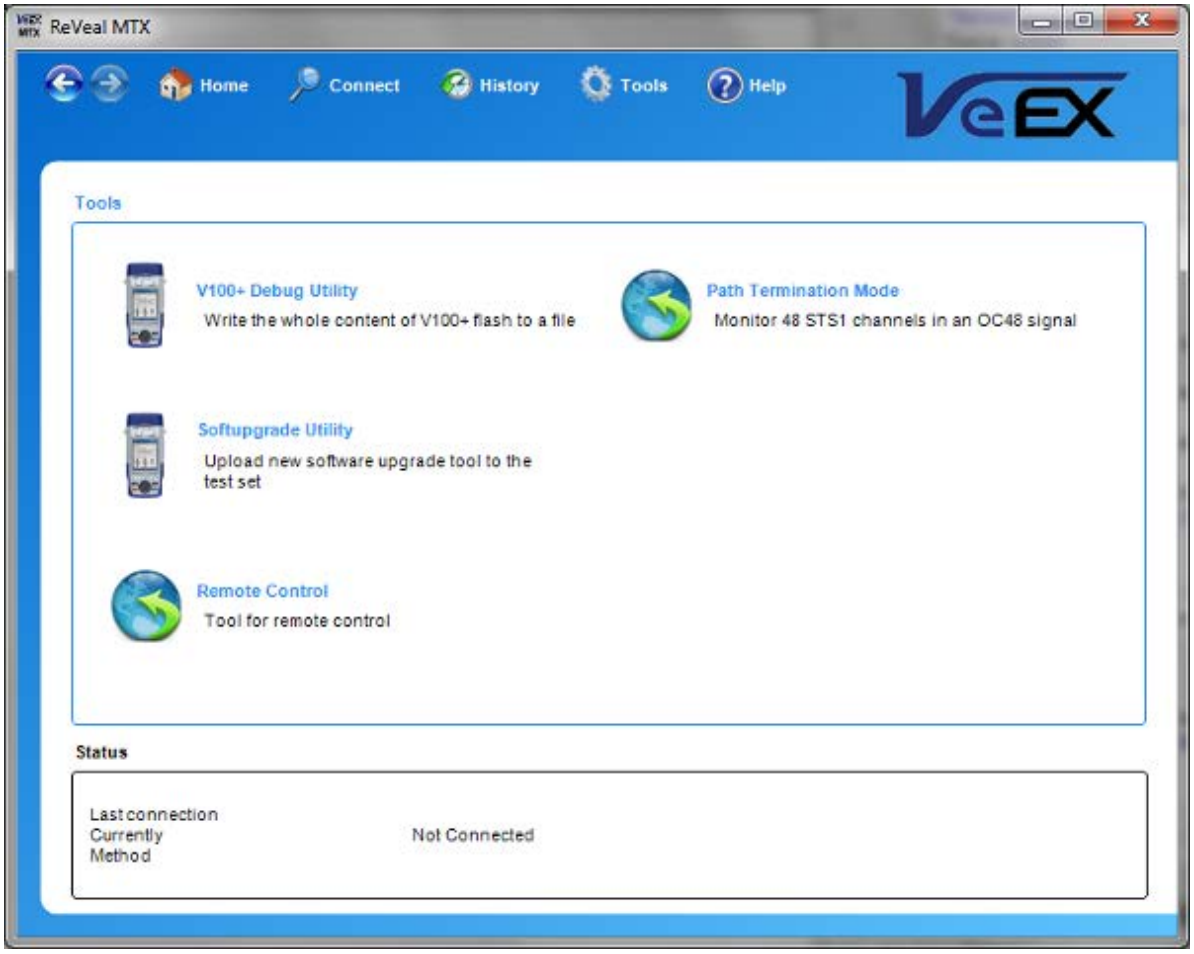
16.4 Tools

16.4.1 Remote Control

- Launch ReVeal MTX software on your PC to remote control the instrument
- The test instrument must be connected to the PC via an IP connection
- Select the remote control application located in the Tools menu
- Start the remote control application

For detailed information, refer to the ReVeal MTX user manual.

ReVeal MTX - Tools Menu



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17.0 Warranty and Software

Warranty Period: The warranty period for hardware, software and firmware are three (3) years from the date of shipment to the customer. The warranty period for battery pack, LCD, LCD touch panel, LCD protective cover, and accessories (including but not limited to patch cords, AC adaptor, SFP, USB adaptors, carrying case, carrying pouch) is limited to one (1) year.

Hardware Coverage: VeEX Inc warrants hardware products against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- Replace the hardware which proves to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Software Coverage: VeEX Inc warrants software and firmware materials against defects in materials and workmanship. During the warranty period, VeEX will, at its sole discretion, either

- Repair the products
- Replace the software and/or firmware which prove to be defective

provided that the products that the customer elects to replace is returned to VeEX Inc by the customer along with proof of purchase within thirty (30) days of the request by the customer, freight prepaid.

Additionally, during the warranty period, VeEX Inc will provide, without charge to the customer, all fixes, patches and enhancements to the purchased software, firmware and software options. VeEX Inc does not warrant that all software or firmware defects will be corrected. New enhancements attached to a software option require the option to be purchased (at the time of order or the time of upgrade) in order to benefit from such enhancements.

Limitations: The warranty is only for the benefit of the customer and not for the benefit of any subsequent purchaser or licensee

of any merchandise (hardware, software, firmware and/or accessories)

Revoking the warranty: VeEX Inc does not guarantee or warrant that the operation of the hardware, software or firmware will be uninterrupted or error-free. The warranty will not apply in any of the following cases:

- Improper or inadequate maintenance by the customer
- Damage due to software installed by the customer on the unit without prior authorization (written) from VeEX Inc
- Unauthorized alteration or misuse
- Damage occurred from operating the unit from outside of the environmental specifications for the product
- Improper installation by the customer

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18.0 Product Specifications

The MX100e+ product specifications are available in pdf format at this link. Please note you will need Adobe Reader version 9.0 or higher to open and view the file.

To get the latest free version of Adobe Reader, click here.

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19.0 Certifications and Declarations

What is CE?

The CE marking is a mandatory European marking for certain product groups to indicate conformity with the essential health and safety requirements set out in European Directives. To permit the use of a CE mark on a product, proof that the item meets the relevant requirements must be documented.
Use of this logo implies that the unit conforms to requirements of European Union and European Free Trade Association (EFTA). EN61010-1

For a copy of the CE Declaration of Conformity relating to VeEX products, please contact VeEX customer service.

What is RoHS?

RoHS is the acronym for Restriction of Hazardous Substances. Also known as Directive 2002/95/EC, it originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products imported into the EU market after **July 1, 2006** must pass RoHS compliance.

Click here for ROHS Statement relating to VeEX products

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20.0 About VeEX

VeEX (Verification EXperts), is an innovative designer and manufacturer of test and measurement solutions addressing numerous technologies. Global presence through a worldwide distribution channel provides uncompromised product and technical support.

Visit us online at www.veexinc.com for latest updates and additional documentation.

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